US Army Corps
of Engineers
Tulsa District

PINE BLUFF ARSENAL

SITE 23A

HC SMOKE TEST POND

SITE CLOSURE PLAN

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JULY, 1985

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DEPARTMENT OF THE ARMY
TULSA DISTRICT, CORPS OF ENGINEERS
OKLAHOMA

July, 1985

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SYNOPSIS

Site 23A, the HC Smoke Test Pond at Pine Bluff Arsenal, Arkansas, will be closed in a FY 86 Military Construction, Army (MCA) project in accordance with all applicable State and Federal regulations. The general investigative procedures followed at Site 23A were to establish the extent and nature of contamination of waste materials both on the surface and in the underlying soils. This included investigations sufficient in scope to determine the vertical and horizontal limits of contaminants present and also to determine if the contaminants would classify as hazardous waste. This contamination consists of heavy metals and hexachloroethane associated with residue from past testing of HC-type smoke pots and grenades, and dumping of HC smoke-related materials. The site materials containing hexachloroethane (HCE) would be classified as RCRA wastes if disturbed since HCE is a RCRA-listed organic compound, however, EP toxicity tests were below RCRA limits. Groundwater data from monitoring wells at the site indicate a plume of contamination in the perched water east of the pond. Contaminants include cadmium, barium, and hexachloroethane.

Additional investigations were made to determine the most effective means of closure that would satisfy the requirements for final disposal of waste material at the site. The subsurface investigations conclude that a low-permeablility clay-shale layer underlies the site and is a suitable lower boundary for an in-situ encapsulation of the waste materials. An integral part of the closure plan would include slurry walls keyed into the clay-shale layer at the boundaries of the encapsulation site with a clay cover for positive control of contaminants. This closure plan encapsulates about 9,700 cubic yards of contaminated wastes from Site 23A and utilizes approximately 51,500 cubic yards of non-RCRA wastes from eight (8) other closure sites as necessary fill material for proper closure of Site 23A. Implementation of this closure plan will result in a savings of $3,900,000 in hazardous waste landfill construction cost since its required capacity would be reduced by 51,500 C.Y. The plan has an estimated cost of $542,600 and is considered to be the most economical and environmentally acceptable alternative, based on the data presented in the following narrative.

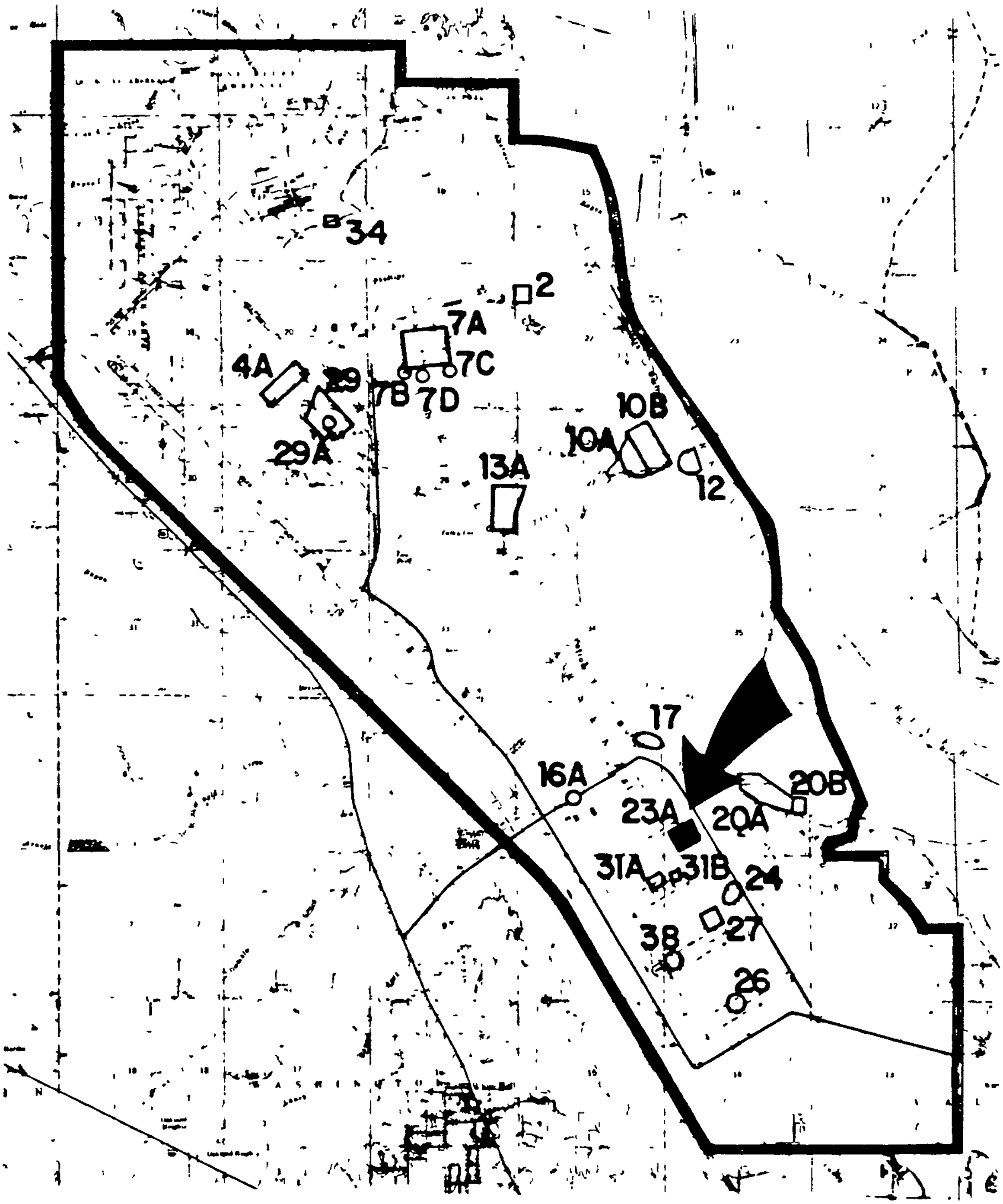
I - GENERAL

1-01. Purpose. This report presents the closure plan for contaminated waste materials located at Site 23A, the HC Smoke Test Pond at Pine Bluff Arsenal, Arkansas. This site is an inactive site and will be permanently closed in accordance with applicable State and Federal regulations. Closure of this site is required to eliminate historical open dumps and prevent contamination of the waters of the State of Arkansas. Discussions between Arkansas Department of Pollution Control and Ecology (ADPC&E), Tulsa District, Corps of Engineers (TDCE), and Pine Bluff Arsenal (PBA) personnel determined that remedial action must be conducted at this site in response to a consent order issued to PBA by the ADPC&E. It was jointly decided to use a negotiation process between the parties similar to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Criteria for hazardous waste set forth in the Resource Conservation and Recovery Act (RCRA) were used to classify materials and manage wastes which will become subject to RCRA during the remedial action process. Cleanup limits for RCRA-listed metal contaminants were dictated by ADPC&E and related to both total ion and EP toxicity testing (see table 3-1).

1-02. Report Format. A site description is presented in Section II. The geotechnical investigations which form the basis for the proposed closure plan are contained in Section III. A description of the proposed closure plan for this site is presented in Section IV. The indicated closure plan is considered to be the most technically feasible, cost effective, and environmentally acceptable alternative based on the results of geotechnical and contaminant investigations, alternative design studies and existing site conditions. Alternative closure plans studied and comparative cost estimates are presented in Sections V and VI, respectively.

II - SITE DESCRIPTION

2-01. Site Description. Site 23A, the HC Test Pond, is a 5-acre wooded area containing a one and one-half acre lagoon and several small burn piles. The site is located in the north portion of the PBA production area, as shown on figure 2-1. It was primarily used as a test area for HC smoke pots and smoke grenades, but was also used as a general dump area for production-related materials. The site was active between 1941 and 1976. HC is a screening smoke composed of approximately 47% zinc oxide, 47% hexachlorethane (a RCRA-listed organic compound), and 6% aluminum. The site is relatively flat with ground surface elevation varying between 232 and 238. The water elevation in the pond is approximately 231.7. Photographs of the site are included in Appendix I.



PINE BLUFF
ARSENAL

CLOSURE SITES

FIGURE 2 - 1

III - GEOTECHNICAL AND CONTAMINANT INVESTIGATIONS

3-01. Introduction. The purpose of the exploration program was to (1) determine the location and properties of any clay strata beneath the site that would be acceptable for use as a lower impermeable boundary in an in-situ encapsulation scheme and (2) define the type, severity, and lateral and vertical extent of contamination.

3-02. Field Investigations.

a. Preliminary. Sixty-five borings, 17.5 feet deep, were drilled at the site during 1973-1975 for the Contaminated Area Survey Project. These samples were tested for heavy metals but were not classified or described. In 1981, one upgradient and three downgradient groundwater monitoring wells were installed. Drill cuttings from these holes were logged in the field. Monitoring well locations are shown on drawing 1.

b. Present. Twenty-eight auger holes 2 to 40 feet deep and one auger-denison hole 25.3 feet deep, were drilled at Site 23A during the spring and summer of 1984, as shown on drawing 1. Soil from the auger holes was described in the field and classified in the laboratory. Each run with the auger was limited to 3 feet. To prevent mixing of materials, or sampling material that had pulled off from the wall of the hole, only the interior portion of each sample was used. Material was taken from the entire length of the sample, sealed in glass or plastic jars and shipped to the Corps of Engineers Southwestern Division (SWD) Laboratory in Dallas. Soil from the auger-denison hole 23-23 was also described in the field. The hole was drilled and sampled to a depth of 17.2 feet with an auger. Three undisturbed denison samples were obtained below this level extending to a total depth of 25.3 feet. These samples were sealed and shipped to the SWD laboratory for falling head permeability tests. Boring 23-22 was drilled 250 feet west of the site and provided background chemical information for the soil at Pine Bluff Arsenal. Holes 23-1, 23-22 and 23-23 were backfilled with grout because they penetrated the clay-shale. Pond water and sediment samples were taken off of a pier which extends about 25 feet from the east bank of the pond as shown on photograph No. 1, Appendix I. Hole 23-21 was drilled here but apparently sampled only HC from a smoke pot. Because of the smoke pot debris in the pond, sediment sampling was not possible. In the spring of 1984, three additional downgradient groundwater monitoring wells were installed at the site and one previously-installed well, 148, was backfilled with grout. Well 148 had been screened through both the perched and the permanent water tables potentially serving as a conduit to channel contaminants from the more contaminated perched water. Of the wells currently in the monitoring program, 3 are screened in the perched water table (including the upgradient well) and 3 are screened in the permanent water table. The wells are regularly tested by the Army Environmental Hygiene Agency for selected parameters. The groundwater data from the wells are available on STORET, a computer system administered by the Environmental Protection Agency.

3-03. Laboratory Testing. Laboratory testing of samples from Site 23A was performed by the Corps of Engineers southwestern Division (SWD) Laboratory in Dallas, Texas and by local laboratories contracted by them. Results of laboratory testing are reported in Appendix II.

a. Chemical Testing Procedures.

(1) Metals

(i) Total ion testing. Soil samples were digested in strong acid and the resulting extracts were tested by atomic absorption spectroscopy techniques. The acid treatment resulted in total ion extraction, freeing the metals from the soil and pore water. A representative portion of the sample was oven dried and the values reported in milligrams/kilogram (mg/kg) dry weight. Tests were conducted for arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver concentrations (the eight RCRA listed toxic heavy metal contaminants). In addition zinc concentrations were determined because of its suspected presence at the site even though it is not a RCRA listed contaminant. Groundwater samples were filtered in the lab, however, surface water samples were not filtered. Both were given a similar acid treatment. The water sample results are reported in milligrams/liter (mg/l).

(ii) EP toxicity testing. Extraction Procedure methodology, commonly referred to as EP toxicity testing, is a much less rigorous extraction of metals, designed to simulate typical leaching conditions in a landfill. Results are reported in mg/l (as a concentration in an extract obtained in a specified manner).

(2) Organics. Soil and water samples were tested by gas chromatograph (GC) techniques. The samples were analyzed for the base/neutral extractable compound hexachloroethane because of its known presence at the site. Analyses were performed by Southwestern Division (SWD) Laboratory in Dallas, Texas.

b. Laboratory Soil Classification. Atterberg limits, sieve analyses, and natural water content tests were performed on selected soil samples. The resulting classifications, based on the Unified Soil Classification System, are used to identify material types shown in the geologic section presented on drawing 2. Laboratory visual classifications were used to verify field classifications.

c. Laboratory Permeability Tests. Two falling head permeability tests were performed in the laboratory on specimens cut from undisturbed (denison) samples of the Jackson clay-shale. The Jackson clay-shale was being investigated for effectiveness as a lower boundary in an encapsulation closure scheme.

3-04. Stratigraphy.

a. General. Site 23A is situated on terrace deposits approximately 18 to 24 feet thick. These deposits consist of silts, sand, and silty clay overlying the Jackson Group. The Jackson consists of about 20 feet of high plasticity clay-shale which overlies a silty sand at about 42 feet beneath the site. The location of this site is shown on a map of geologic environments at Pine Bluff Arsenal (figure 3-1). There are two types of fill present at the site (1) smoke pots and wastes from the HC manufacturing process and (2) burned debris in scattered areas east of the pond. The wastes from the manufacturing process consist of a whitish to light gray granular sludge-like material with a strong solvent odor. Included in this sludge are pieces of wood, rusted cans, metal bands, and pieces of work clothing. This material is as much as 11 feet thick and appears as the whitish area on the east bank of the pond as shown on photograph No. 1, Appendix I, and the geologic section, drawing 2. The depth of this material beneath the pond has not been determined. The burned debris in scattered areas east of the pond is a dark, sandy material. It is 1 to 2 feet thick.

b. Terrace Deposits. The terrace deposits consist of silts, sands and low plasticity clays. The clays exist in discontinuous lenses and generally have liquid limits less than 30. The terrace deposits at this site are 18 to 24 feet thick.

c. Jackson Group. A geologic section is presented in drawing 2. The uppermost bed of the Jackson at Site 23A is a clay-shale. Depths to the clay-shale range from 18 feet at MW 149 to 24 feet at hole 23-1. Falling head permeability tests were performed at the SWD laboratory on two samples taken from hole 23-23. At a depth of 18.0 to 20.0 feet, a permeability of $1.5X10^{-9}$ cm/sec was found. At a depth of 23.0 to 24.8 feet, tests give a permeability of $3.9X10^{-9}$ cm/sec. The 20 foot thickness, absence of sand lenses, and relative impermeability of the clay-shale make it an excellent stratum for use in an in-situ encapsulation scheme.

d. Water Table. Perched water occurs above the clay-shale, about elevation 225. The permanent water table occurs about elevation 200 and slopes gently to the northeast.

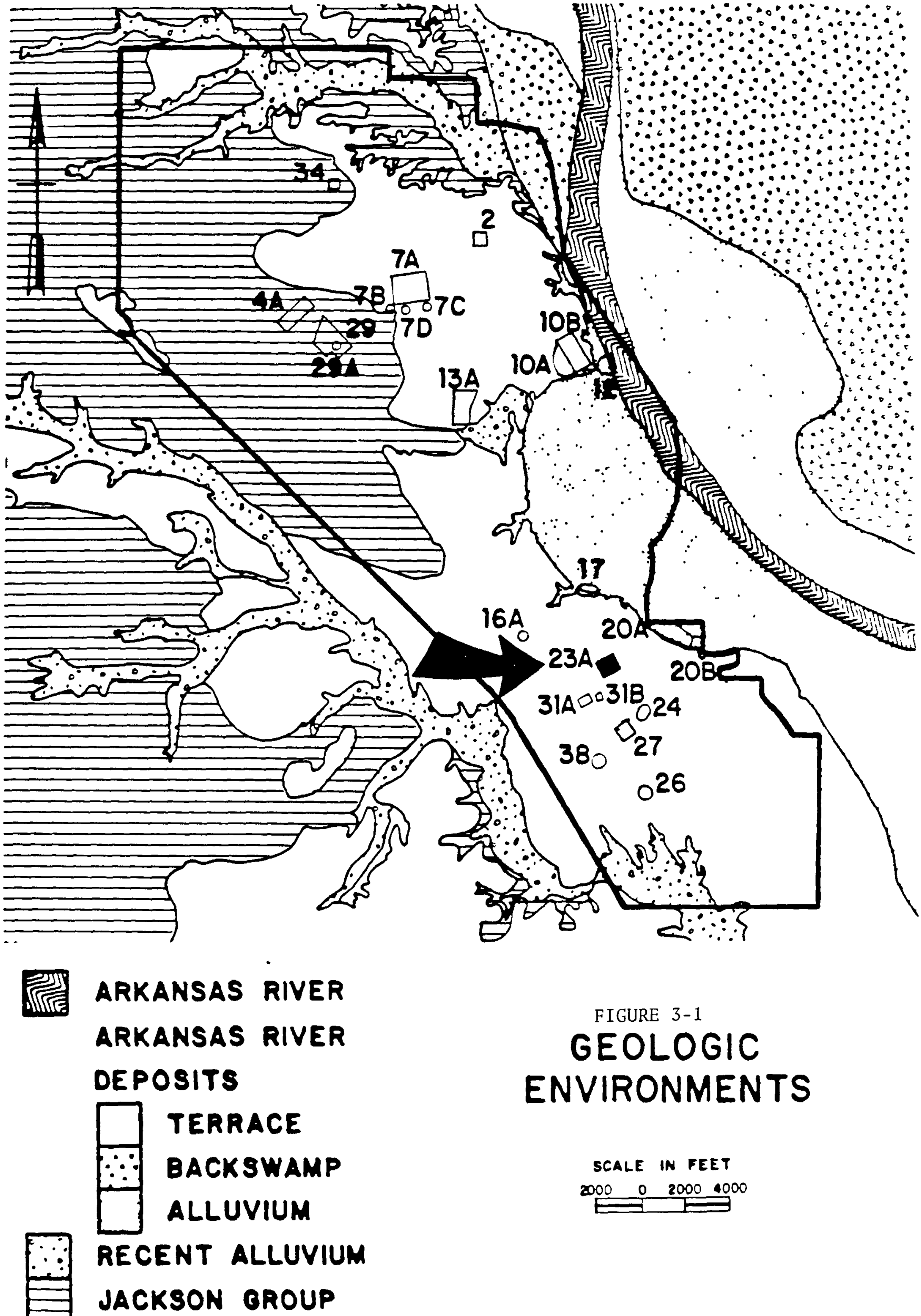


FIGURE 3-1
GEOLOGIC ENVIRONMENTS

3-05. Analysis.

a. Contamination Background Levels and Cleanup Limits. An administrative consent agreement between the ADPC&E and PBA is the basis for this remedial action. This agreement is predicated on Arkansas law which prohibits pollution of Arkansas waters but does not identify contaminants or allowable limits. Through discussions and letters, the ADPC&E identified parameters and concentrations of concern as follows:

(1) Heavy Metals.

(i) Total Ion Concentrations. The maximum contaminant levels (MCL) for the 8 heavy metals listed in RCRA (40 CFR 261.24) were set at 10 times the background levels. "Arsenal-wide" background levels were calculated as the mean of 102 samples collected in uncontaminated areas near 17 of the sites.

(ii) EP toxicity concentrations. In addition to meeting the MCL for the total ion method, the ADPC&E also required that the samples not exceed one-tenth the regulatory values shown in RCRA (40 CFR 261.24) when analyzed using EP methodology. Table 3-1 lists background levels and MCL's (cleanup limits) for these heavy metals.

TABLE 3-1

HEAVY METAL BACKGROUND LEVELS AND CLEANUP LIMITS

Contaminant	Background Mean (mg/kg)	Site Cleanup Limits Total Ion MCL (mg/kg)	Site Cleanup Limits EP Toxicity MCL (mg/l)
Arsenic (As)	1.3	13.0	0.5
Barium (Ba)	28.7	290.0	10.0
Cadmium (Cd)	<0.5	5.0	0.1
Chromium (Cr)	<5.0	50.0	0.5
Lead (Pb)	7.55	75.5	0.5
Mercury (Hg)	<0.1	1.0	0.02
Selenium (Se)	0.18	1.8	0.1
Silver (Ag)	<0.5	5.0	0.5
Zinc (Zn) (1)	8.5	(1)	(1)

(1) Background level for zinc was determined since it is a common constituent of demilitarized ordnance wastes. Zinc is not a RCRA-listed contaminant, therefore, cleanup limits were not required by ADPC&E.

(2) Organics. A GC-mass-spectrometer scan was conducted on samples from those sites where there is evidence of disposal of organic compounds.

At those sites where the tests revealed the presence of compounds listed in RCRA (40 CFR 261.33), an individual determination of the substance hazard was made. This was dependent on the compounds and the amount present in the sample. This determination was used to develop the recommended closure plan and is subject to approval of the ADPC&E. The organic compounds of primary concern are not naturally occurring, therefore, no organic testing was conducted on background samples collected in uncontaminated areas.

b. Determining Extent of Metal Contamination. Samples from selected holes were tested for arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, zinc, and pH. Lead and zinc were found to be present in the highest concentrations and were selected for testing in the remaining holes. Hole 23-16 was found to have high total ion concentrations for all eight RCRA-listed metals and was also tested for EP toxicity. The depth to which soil would be contained or removed in the cleanup of Site 23A was determined by comparing the measured values of each contaminant with the cleanup values presented in table 3-1. These data are presented graphically for each boring in Appendix III. With the results plotted in this manner the depth of contamination and the depth of soil to be contained or removed is easily determined. The plots also show contamination in the fill material whether or not samples of the material were tested.

c. Metal Contamination Results.

(1) Fill and Underlying Soil, Total Ion Testing. Approximately two acres of Site 23A are covered with fill material and contaminated soil. Fill material is 11 feet thick on the eastern edge of the pond and thins rapidly away from the pond. Contaminated soil is present approximately 1 foot beneath the fill. An isopach of contaminated material at Site 23A is found on drawing 2. Depths of contamination beneath the pond are assumed since sediment sampling was not possible. At least one foot of contamination is assumed to be present over the entire bottom of the pond. The total quantity of contaminated material at Site 23A is estimated to be 9,700 cubic yards. All eight RCRA listed heavy metal contaminants and zinc were present in the fill. The fill from the smoke pots and HC manufacturing process is not significantly different from the burned debris in the eastern parts of the site in the types and concentrations of contaminants it contains. Lead and zinc are the primary contaminants with concentration as high as 2900 mg/kg lead and 460,000 mg/kg zinc in the fill and 75 mg/kg lead and 51,000 mg/kg zinc in the underlying soil. Lesser amounts of arsenic, barium, cadmium, chromium, mercury, selenium, and silver were found in the fill material. Concentrations in the fill ranged from 10 to 29 mg/kg As, 20 to 1700 mg/kg Ba, 5 to 71 mg/kg Cd, 30 to 45 mg/kg Cr, 0.1 to 45 mg/kg Hg, 0.5 to 1.3 mg/kg Se and 2 to 5 mg/kg Ag. No barium, mercury, silver, chromium or selenium was detected in the underlying soil. Small concentrations of cadmium and arsenic were detected in the soil underlying the fill. Highest concentrations in the soil were 9.1 mg/kg As and 10 mg/kg Cd.

(2) Fill and Underlying Soil, EP Toxicity Testing. EP toxicity tests were performed on samples from holes drilled along the alignment of the slurry trench closure cell from Site 23A to insure that metal concentrations were less than the cleanup limits for EP toxicity (table 3-1) at the boundary of the site closure. In addition, two highly contaminated samples of fill (as determined by total ion content) were tested for EP toxicity in order to measure the degree of contamination in the worst part of the site. Results of all EP toxicity testing are presented in table 3-2.

(3) Pond water. Test results from the pond water samples indicated the presence of barium, cadmium, lead, zinc, and arsenic. Barium and cadmium concentrations were found to be above drinking water quality (NIPDWR) standards (1.62 mg/l Ba and 0.13 mg/l Cd). Water quality standards are 1.00 mg/l for Ba and 0.05 mg/l for Cd. Concentrations of the other detected metals were found to be at or below NIPDWR standards (0.05 mg/l Pb, 1.28 mg/l Zn and 0.002 mg/l As). Approximately 2,500,000 gallons of water are in the pond.

d. Extent of Organic Contamination. Two water samples and soil samples from fourteen borings were sampled and analyzed for the base/neutral extractable compound, hexachloroethane (HCE) a colorless solid with a camphor-like odor. It has a solubility in water of 50 mg/l, and accounts for almost half of the smoke mix. Both fill and soil were analyzed. HCE content was also determined in samples from borings on the slurry trench alignment (borings 28-35). Test results revealed levels of 200,000 to 240,000 mg/kg HCE in the fill along the banks of the pond. HCE is confined to the fill except in the vicinity of hole 23-1, where fill is the thickest. In that hole, a concentration of 620 mg/kg was found in the soil, 4 to 6 feet below the base of the fill. No hexachloroethane was detected along the slurry trench alignment. Complete results of HCE soils/fill testing at Site 23A are presented in table 3-3. Results of water analysis from auger hole 23-1 revealed only 0.45 mg/l HCE at a depth of 2.6 feet. Similarly a water sample from monitoring well 149 had a concentration of 0.207 mg/l HCE, however, the pond water (2-3 feet depth) contained less than 0.001 mg/l.

TABLE 3-2

RESULTS OF EP TOXICITY ANALYSIS

(mg/l)

Hole	Depth (1)	Ag	As	Ba	Cd	Cr	Hg	Pb	Se
1	10.0-12.0	<0.01	0.001	< 0.5	0.072	0.02	0.0001	0.63(2)	< 0.0004
1	12.0-14.0	<0.01	<0.001	< 0.5	0.028	<0.01	<0.0001	0.02	< 0.0004
16	0.0-0.6	<0.01	<0.001	< 0.5	0.005	<0.01	<0.0001	0.02	< 0.0004
16	3.0-6.0	<0.01	<0.001	< 0.5	0.200(2)	<0.01	<0.0001	0.06	< 0.0004
28	0.0-0.8	<0.01	<0.001	0.86	0.077	0.02	<0.0001	0.37	< 0.0004
28	9.0-12.0	<0.01	<0.001	< 0.5	0.007	<0.01	<0.0001	0.03	< 0.0004
29	0.0-3.0	<0.01	<0.001	< 0.5	0.022	<0.01	<0.0001	0.07	< 0.0004
29	8.0-11.0	<0.01	<0.001	< 0.5	0.005	<0.01	<0.0001	0.02	< 0.0004
30	2.0-2.5	<0.01	<0.001	< 0.5	0.005	<0.01	<0.0001	0.07	< 0.0004
30	9.3-9.8	<0.01	<0.001	< 0.5	0.005	<0.01	<0.0001	<0.01	< 0.0004
31	0.0-3.0	<0.01	<0.001	0.98	0.005	<0.01	<0.0001	0.05	< 0.0004
31	12.0-15.0	<0.01	<0.001	< 0.5	0.005	<0.01	<0.0001	0.05	< 0.0004
32	0.0-3.0	<0.01	<0.001	< 0.5	0.005	<0.01	<0.0001	0.05	< 0.0004
33	0.0-3.0	<0.01	<0.001	< 0.5	0.003	<0.01	<0.0001	<0.01	< 0.0004
33	12.0-15.0	<0.01	0.001	< 0.5	0.008	<0.01	<0.0001	0.13	< 0.0004
34	1.5-2.0	<0.01	<0.001	< 0.5	0.005	<0.01	<0.0001	0.08	< 0.0004
34	11.5-12.0	<0.01	<0.001	< 0.5	0.003	<0.01	<0.0001	0.06	< 0.0004
35	0.0-3.0	<0.01	<0.001	< 0.5	0.003	<0.01	<0.0001	0.04	< 0.0004
35	12.0-13.5	<0.01	<0.001	< 0.5	0.008	<0.01	<0.0001	0.02	< 0.0004
RCRA limit		5.0	5.0	100.0	1.0	5.0	0.2	5.0	1.0

(1) For location of sample tested for EP toxicity in holes 1 and 16, see the boring column in Appendix III, Boring-Contaminant Plots.

(2 Indicates that this value exceeds the ADPC&E cleanup limit for EP toxicity (10% of the RCRA limit).

TABLE 3-3

RESULTS OF HEXACHLOROETHANE (HCE) ANALYSES

Hole	Depth	Type Mat'l	Concentration (mg/kg)
23-1	0.0-1.0	fill	19,000
23-1	2.0-3.0	fill	220,000
23-1	5.0-8.0	fill	200,000
23-1	10.0-12.0	soil	22,000
23-1	14.0-16.0	soil	620
23-3	1.0-3.0	soil	0.3
23-4	0.3-1.0	fill	160,000
23-4	3.0-5.5	fill	240,000
23-4	8.5-10.5	soil	15
23-5	0.5-2.2	fill	24,000
23-6	0.0-1.0	soil	1.1
23-6	1.0-2.0	soil	0.4
23-7	0.0-1.0	soil	3.6
23-7	2.0-3.0	soil	1.0
23-7	7.0-10.0	soil	0.3
23-8	0.0-1.0	fill	0.4
23-8	2.0-3.0	soil	0.3
23-20	0.0-1.0	soil	0.2
23-20	2.0-5.0	soil	0.6
23-28	0.0-0.8	soil	0.1
23-28	9.0-12.0	soil	0.1
23-29	8.0-11.0	soil	0.1
23-30	7.3-9.3	soil	0.1
23-33	0.0-3.0	fill	0.1
23-34	1.5-2.0	soil	0.1
23-34	11.0-11.5	soil	0.1
23-35	12.0-13.5	soil	0.1

e. Groundwater Contamination.

(1) General. Groundwater encountered at Site 23A belongs to the Jackson/Quaternary aquifer. This aquifer generally yields small amounts of poor quality water and is not used for any water supply purpose in the vicinity of the arsenal. Drinking water in the area is supplied from the Sparta Sand which is about 600 feet below the site and is separated from it by low permeability Jackson and upper Claiborne groups. Tests have been performed on groundwater samples from the monitoring wells over a period of two years. Table 3-4 summarizes the chemical test results from the monitoring wells and auger holes that exceed NIPDWR standards.

(2) Perched Water Table. There is contamination in the perched water table downgradient of the site as is evidenced by the high barium and cadmium in both monitoring well 149 and the auger hole. Total organic halogen is much higher in the downgradient perched well (149) than any other wells. A water sample from this well contained 0.207 mg/l of hexachloroethane.

(3) Permanent Water Table. The permanent water table is monitored by downgradient wells #146, 193 and 195. Barium, chromium and lead concentrations in these wells are above arsenal background levels (table 3-1). The chromium (0.46 mg/l) and lead (1.07 mg/l) concentrations exceeded NIPDWR standards during one sampling of well 146. Since cadmium was not present in the permanent water samples and chromium did not appear in the perched water samples, it does not appear that the pond has contaminated the permanent water table. This lack of contamination is presumably due to the 20 foot thick Jackson clay-shale layer located immediately above the permanent water table.

TABLE 3-4

SURFACE WATER QUALITY SUMMARY

(all results in mg/l)

Location	Water Table	Upgradient or Downgradient	Contaminants Exceeding NIPDWR Standards				Highest TOC(1)	Highest TOX(2)	HCE
			Ba	Cd	Cr	Pb			
Well 146	Permanent	Downgradient	--	--	0.46	1.07	40	0.190	(3)
Well 147	Perched	Upgradient	--	--	--	--	44	0.045	(3)
Well 148	Permanent & Perched	Downgradient	--	0.01	--	0.13	70	0.410	(3)
Well 149	Perched	Downgradient	5.0	0.52	--	0.12	38	21.0	0.207
Well 23-1	Perched	Downgradient	1.6	0.13	--	--	--	--	0.45
Pond	-	-	1.62	0.13	--	0.05	--	--	<0.001
NIPDWR Standard			1.0	0.01	0.05	0.05	--	--	--

(1) Total Organic Carbon
(2) Total Organic Halogens
(3) No Test Conducted

IV - CLOSURE PLAN

4-01. General. The existence of the clay-shale layer discussed in Section III forms the basis for the proposed method of in situ encapsulation. It is planned to utilize this clay-shale layer as the lower boundary of a closure cell. A slurry wall would be keyed into this clay-shale layer a minimum of 2 feet. Approximately 4.24 acres of the site would be enclosed by the wall and would contain about 9,000 cubic yards of in-situ contaminated material. The remaining 0.29 acres of contaminated material outside the wall (approximately 750 cubic yards) would be excavated and placed within the limits of the wall, in the dewatered pond. The volume enclosed by the wall would be filled, graded and covered with a clay cap. This type of closure is considered to be consistent with RCRA regulations since (1) all EP Toxicity test results were within RCRA Limits, (2) only a minimal volume of soil located outside the proposed trench alignment is contaminated with hexachloroethane and (3) the concentrations of hexachloroethane in the outlying soils are very low. The proposed closure plan is shown on drawing 3. Construction of this closure cell would be accomplished as follows:

a. Diversion Channels and Containment Levee. Diversion channels would be constructed outside the perimeter of the slurry wall alignment to divert surface drainage around the closure site. Of upmost importance is the diversion channel along the east side of the enclosure cell, as illustrated on drawing 3. This channel would require approximately 1000 cubic yards of excavation. A containment levee would be constructed along the slurry wall alignment, to assist in preventing run-on of surface water, and to provide storage capacity within the cell. This levee would require approximately 3200 cubic yards of low-permeability fill material.

b. Slurry Wall. Upon completion of grading the slurry wall alignment and containment levee, the slurry trench will be excavated and backfilled with a soil-bentonite mixture. A wall thickness of 30 inches is adequate since there will no hydrostatic head on the wall. It is anticipated that the elevation of the perched water in the area will be lowered substantially by dewatering the pond. A backfill mix will be designed that achieves a permeability of 1×10^{-7} cm/sec or lower. Mix designs will be performed using material from required wall excavations and tested for the required permeability. The slurry wall will be keyed a minimum of 2 feet into the Jackson clay-shale layer resulting in an average wall height of 20 feet. Run-on control channels constructed outside the wall would be maintained to insure surface water did not cross the top of the containment levee and slurry wall into the pond area.

The effect of dilute concentrations of hexachloroethane on the permeability of the lower boundary Jackson clay-shale is predictably minor. Results of laboratory tests which simulate the relatively low concentrations of many classes of organic leachate on various types of clay (under realistic hydraulic gradients) suggest that the permeability of the clay is not greatly affected.(1)(2)(3)

c. Pond Dewatering. The pond which borders the western area of Site 23A would be dewatered by pumping the estimated 2,500,000 gallons to natural drainage. Water quality tests indicate concentrations of heavy metals present in the pond water samples are only slightly above NIPDWR standards. Consequently, a one-time discharge of the pond water would not create adverse environmental effects.

d. Pond Filling/Contaminated Material Relocation. Contaminated material along the slurry wall alignment and outside the alignment would be stripped, moved into the wall interior and compacted inside the pond. Due to the debris, rubble, and sludge layer in the pond bottom, the initial fill layer would be end dumped in a layer approximately three feet thick. The surface of this bridging layer would then be compacted, with subsequent layers compacted in 6 to 8 inch lifts. Approximately 750 cubic yards of contaminated material will require moving into the limits of the slurry wall. The excavated area resulting would be scarified, compacted, then backfilled with compacted layers up to the natural grade, as necessary to eliminate ponding. The top 6-inches of backfill would be topsoil. The topsoil would be fertilized and seeded, as necessary for complete revegetation. Of the 750 cubic yards to be replaced, approximately 250 cubic yards would be topsoil, and 500 cubic yards would be random fill material, suitable for subsoil.

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(1) "Effects of Chemicals on the Hydraulic Conductivity of Clay", David E. Daniel, University of Texas at Austin, 1983 Draft Paper.

(2) "Organic Leachate Effects on Hydraulic Conductivity of Compacted Kaolinite", Hamidon, A., Acar, Y., Field , S., and L. Scott, presented at the shortcourse: "Geotechnical Engineering for Waste Disposal Projects", University of Texas at Austin.

(3) "Soils-Bentonite Slurry Trench Cutoffs", David J. D'Appolonia, April, 1980 Journal of the Geotechnical Engineering Division, American Society of Civil Engineers.

The pond is estimated to contain 2,500,000 gallons of water, which must be replaced with 12,400 cubic yards of fill. An additional 42,600 cubic yards of fill material is needed between the current water surface level and the bottom of the clay cap (this volume would be subject to change, if the elevation or slope of the clay cap was revised from that illustrated on drawing 3). Consequently, the pond area has a total fill requirement of 55,000 cubic yards. Due to bulking and over excavation, it is anticipated that 1,050 cubic yards of the pond volume will be utilized by the 750 cubic yards of on-site contaminated material that is to be moved. This leaves about 54,000 cubic yards of fill material needed at Site 23A. This could either be random soil fill material, or compatible contaminated waste material from other remedial action sites. Due to the substantial disposal cost savings which result (see Section VI), it is proposed that the required fill material be composed primarily of contaminated wastes from other sites. Sites proposed for disposal at Site 23A are listed table 4-1. Compatibility test reports (see Appendix IV) indicate that materials from these sites are suitable for disposal at Site 23A. The Site 29 wastes included in Table 4-1 are only those from the South contaminated area which have non-RCRA waste characteristics. The contaminated material in the North area has RCRA waste characteristics and will be closed in-situ by means of a clay encapsulation cell. Refer to the Site 29 Closure Plan for additional details.

TABLE 4-1

OTHER SITES TO BE DISPOSED AT SITE 23A

Site No.	Waste Material
Site 2	350 CY
Site 10A	6,200 CY
Site 12	15,500 CY
Site 17	5,900 CY
Site 20B	2,900 CY
Site 26	4,800 CY
Site 29 (South Area Only)	15,200 CY
Site 31A	700 CY
Total	51,550 CY

e. Cover and Grading. Once all contaminated material and random fill has been placed within the cell it would be graded to provide a 5 percent maximum slope for drainage and maximum waste storage capacity. Then the cell would be capped with a 2-foot thick clay cover equivalent to that of the slurry wall ($1X10^{-7}$ cm/sec) to prevent vertical migration of contaminants and to provide run-on/off control. The entire disturbed area of the site and the closure cell would be covered with 6 inches of topsoil and revegetated.

f. Run-on Control Channels. Drainage channels around the perimeter of the cell (see drawing 3) would receive a two-foot thick clay layer in their bottoms, followed by a final grading and seeding. The principal channel along the east side would also receive a layer of erosion control fabric.

g. Rainwater Containment and Disposal. Construction of the slurry wall and run-on control facilities, as previously described, would virtually eliminate site water problems during construction resulting from groundwater infiltration and inflow from surface waters. These facilities would not eliminate accumulation of water from rainfall which falls within the limits of the run-on control channels and levees. A sump area would be maintained during pond backfilling operations to provide positive drainage within the backfill. Water accumulating in this sump would be periodically tested and hauled to the industrial waste treatment plant for disposal if it is classified as being contaminated. This sump area would be dewatered and backfilled during a dry weather period just prior to installing the clay cover and topsoil in its immediate vicinity.

h. Operation and Maintenance. The site would remain closed to burning or surface debris disposal indefinitely. The site would require maintenance for a period of approximately 2 years to prevent erosion until vegetative growth is firmly established. Periodic inspections would be conducted thereafter to insure against potential erosion and settlement problems. Additional groundwater monitoring wells will be installed after closure. Four pairs of wells (one each in the permanent and perched water) will be added. One pair will replace well 147, the upgradient well, which is too close to the run-on ditch to be retained. Three downgradient pairs will be located near the cell, and well 149 will be relocated just outside the alignment. Wells will be sampled every 6 months and tested for the following parameters:

arsenic	mercury	sodium
barium	selenium	sulfate
cadmium	silver	pH
chromium	chloride	specific conductance
lead	iron	zinc

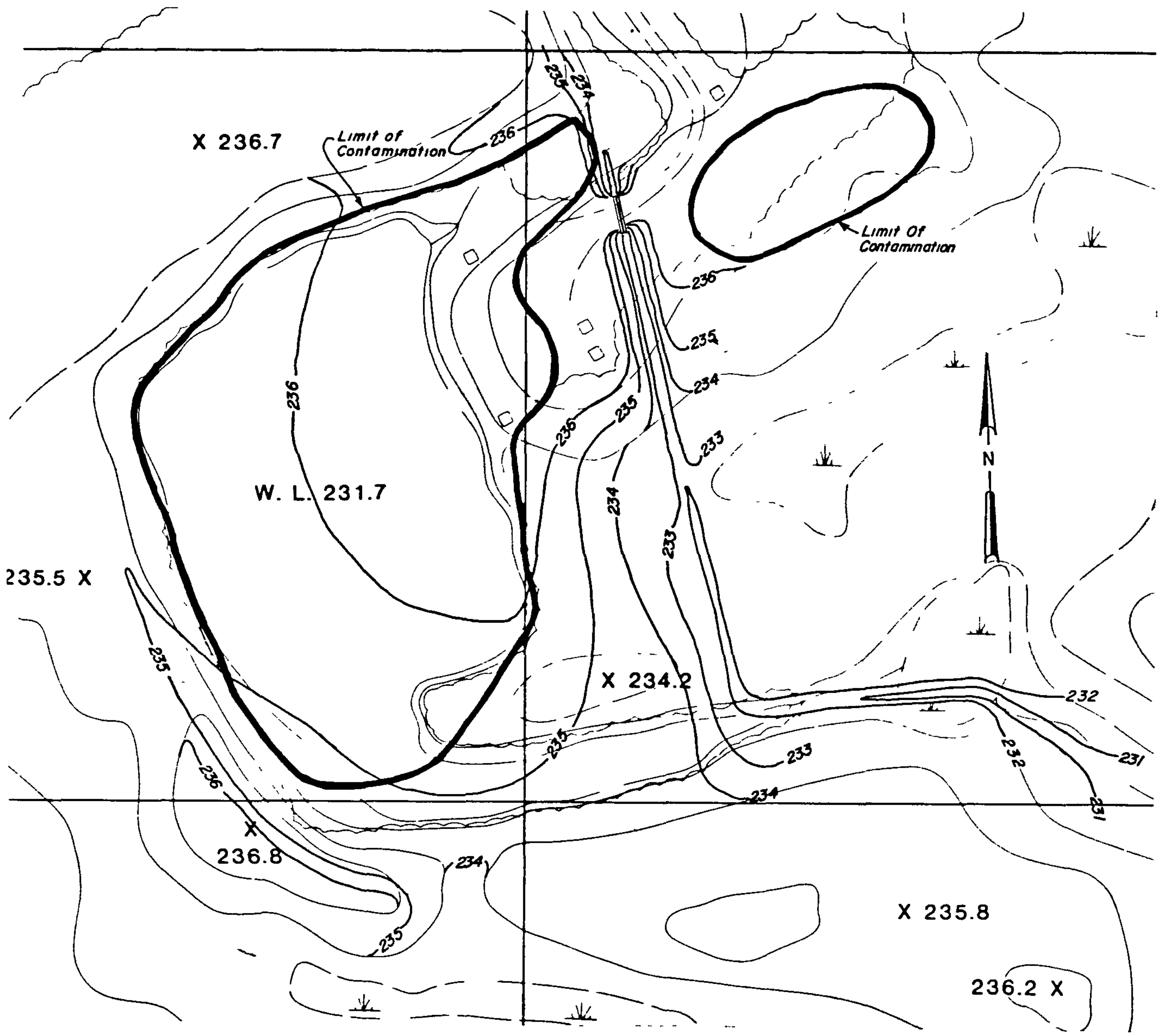
In addition, well samples will be tested for the EPA priority pollutant base/neutral extractable organic compounds annually.

V - ALTERNATIVE CLOSURE PLAN

5-01. General. This alternative plan evaluates the feasibility of moving the contaminated material at this site to a hazardous waste landfill. It has been estimated that 10,000 cubic yards of contaminated material exists at the site. Since the extent of the debris and contamination in parts of the pond bottom are unknown, this quantity could be incorrectly estimated. The nature of the sludge and debris in the pond are such that this material would require drying and compaction steps before the material was suitable for landfill disposal.

After dewatering the pond and drying the material, all contaminated material would be hauled to the hazardous waste landfill. The site would be backfilled, graded, topsoiled and seeded, as indicated in figure 5-1. Fill material and topsoil would be required to replace the contaminated material, the 2.5 million gallons of pond water (12,400 CY) and to fill the pond depression up to an average grade of approximately 235.5, as necessary to prevent future ponding (9,000 CY). Approximately 32,600 cubic yards of off-site fill material would be required, of which 3,200 would be topsoil and 29,400 cubic yards would be random soil fill material. The drainage channel entering the site would be routed around the pond location, similar to the on-site closure plan, in order to prevent erosion of the topsoil and fill.

The hazardous waste landfill capacity required for this closure plan has been based on 13,400 cubic yards of material which allows for 15% overexcavation and a 20% volume increase to reflect the bulking which occurs during placement and recompaction.



GRADING PLAN

SCALE IN FEET

50 0 50 100

LEGEND

EXTENT OF CONTAMINATION

234 FINAL CONTOURS

FIGURE 5-1

SITE 23A

SITE GRADING PLAN

ALTERNATIVE OFF-SITE

CLOSURE PLAN

VI - COSTS

6-01. General. Unit prices are based on those listed in the Concept Design Analysis, prepared by the Tulsa District and dated August, 1984. The cost estimates include an adjustment to January, 1987 price levels. Where appropriate unit prices are not included in the referenced document, recently received bid prices and/or published unit cost data have been utilized.

6-02. Cost Comparison of Closure Plans. Table 6-1 presents a cost estimate for the proposed closure plan. Table 6-2 lists a cost estimate for an alternative off-site closure plan. This table is more general than table 6-1, but contains sufficient information to document the cost differential associated with the off-site closure alternative. Alternative plan costs are summarized as follows:

Proposed On-Site Closure Plan	$ 542,600
Off-Site Closure Plan, including Prorata Landfill Capacity Costs	$1,244,000

This comparison indicates a costing savings of $701,400 for the proposed closure plan. Furthermore, the proposed plan includes disposal of 51,500 C.Y. of wastes from 8 other closure sites (See Section IV), therefore, an additional savings of approximately $3,900,000 will occur since the hazardous waste landfill capacity can be reduced accordingly.

TABLE 6-1
COST ESTIMATE
PROPOSED CLOSURE PLAN

Item	Unit	Unit Price[1]	Quantity	Estimated Cost
Clearing and Grubbing	AC	$2,200.00	3.6	$ 7,920
Random Excavating	CY	3.60	1,000	3,600
Compacted Low Permeability Fill	CY	9.50	20,200	191,900
Slurry Wall	SF	5.80	31,800	184,440
Move Contaminated Material	CY	5.80	860	4,988
Random Fill	CY	3.60	600	2,160
Topsoil (6")	CY	8.75	4,900	42,875
Revegetation	SY	0.35	29,500	10,325
Erosion Control Fabric	SY	1.60	820	1,312
Dewater Pond	LS	-	L.S.	3,000
Culvert	Ft.	44.00	30	1,320
Monitoring Wells	Ea.	6,000.00	6	36,000
Subtotal				$ 489,840
Contingencies @ 5%				24,492
Subtotal				$ 514,332
Supervision and Inspection @ 5.5%				$ 28,268
ESTIMATED TOTAL				$ 542,600

(1) Unit prices include 26.5% for overhead and profit and 15% for cost escalation to January, 1987

TABLE 6-2
COST ESTIMATE
OFF-SITE ALTERNATIVE CLOSURE PLAN

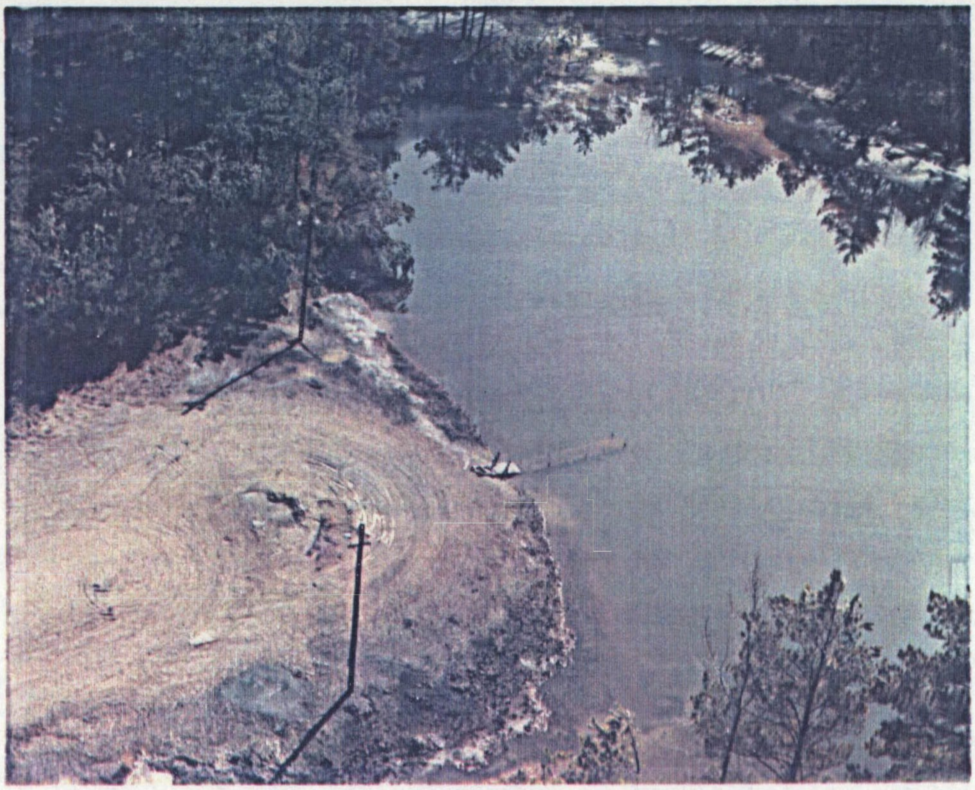
Item	Unit	Unit Price(1)	Quantity	Estimated Cost
Clearing and Grubbing	AC	$2,200.00	1.8	$ 3,960
Move Contaminated Material	CY	5.80	11,150	64,670
Random Fill	CY	3.60	29,400	105,840
Topsoil (6")	CY	8.75	3,200	28,000
Revegetation	SY	0.35	19,000	6,650
Erosion Control Fabric	SY	1.60	820	1,312
Dewater and Dry Pond	LS	-	L.S.	4,000
Culvert	FT.	44.00	30	1,320
Subtotal				$ 215,752
Contingencies @ 5%				10,788
Subtotal				$ 226,540
Supervision and Inspection @ 5.5%				12,460
ESTIMATED TOTAL COST (2)				$ 239,000

(1) Unit prices include 26.5% for overhead and profit and 15% for cost escalation to January, 1987.

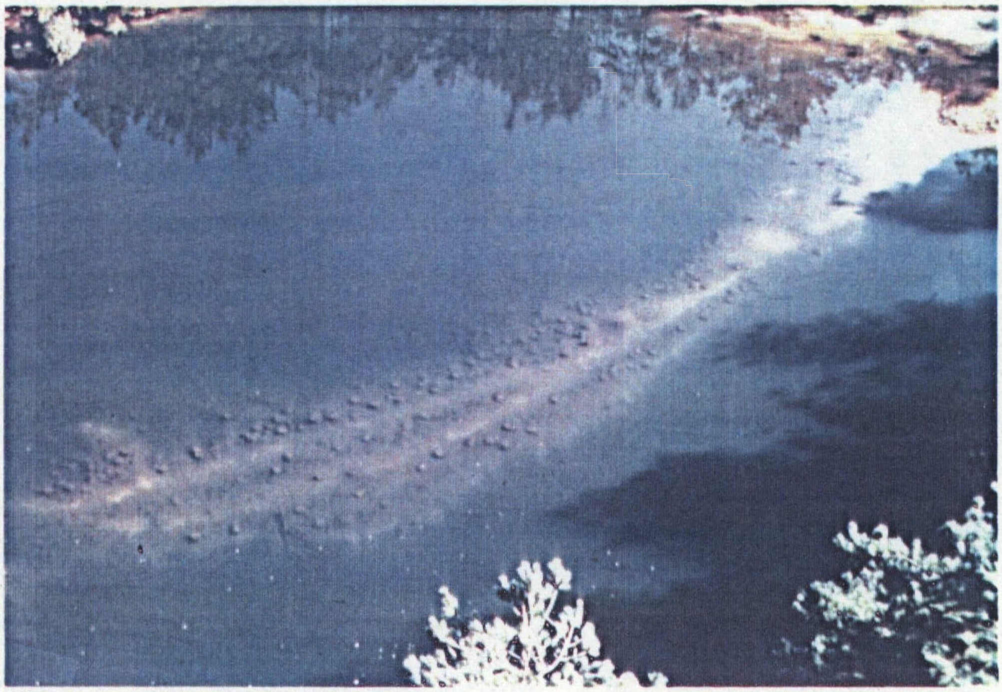
(2) The prorata landfill construction cost for an increased capacity of 13,400 cubic yards is $1,005,000. Therefore the total capital cost of this alternative closure plan is $1,244,000.

APPENDICES

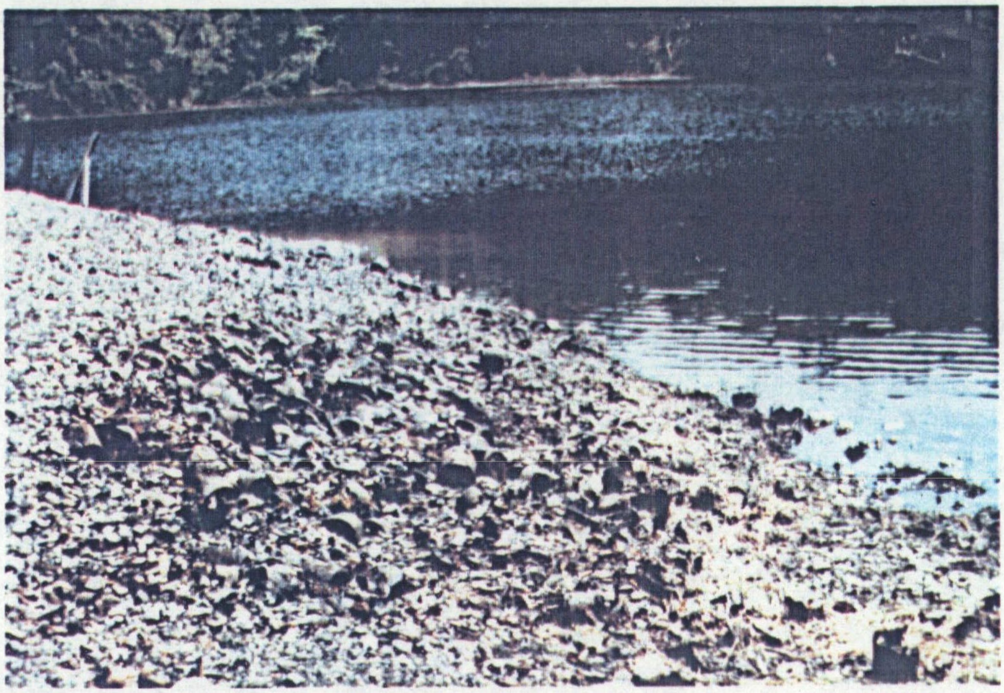
APPENDIX I
SITE PHOTOGRAPHS



VIEW OF HC POND, LOOKING SOUTH
WHITISH AREA ON SHORELINE IS HC DUMP



VIEW OF HC POND, LOOKING SOUTH
SMOKE POTS CAN BE SEEN IN THE POND



CLOSE UP OF BURN DEBRIS

OVERFLOW DRAINAGE ON NORTH SIDE OF SITE

APPENDIX II
LABORATORY, CHEMISTRY AND SOILS REPORTS

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13736 **(** 4 **pages)**

PROJECT: Pine Bluff Arsenal
Feature: Close Hazardous Waste Site 23

Contract No.:

TEST REQUEST NO.: Telephone
Dated: 16 Mar 84
Received:

From:
Geotech Branch
Tulsa District

MATERIAL: Soil and water
No. and type of samples: 49 soil and 4 water samples
Source or other identification: Holes 1 thru 21

Date received: 9, 19 March 1984

REMARKS:

Results of Chemical Analysis of Soil	Table 1
Results of Chemical Analysis of Water	Table 2

Results of tests telephoned to TDO on 28, 30 March and 3 April 1984.

Report sent to:

Tulsa District

Copy furnished:

Date:
13 April 84

Name and title:
ARTHUR H. FEESE
Director
SWD Laboratory

Signature

SWD FORM 896
8 SEP 77

SWDED-GL Report 13736

Table 1

Pine Bluff Arsenal
Site 23

Results of Chemical Analysis of Soil(1)

SWD Lab No	Site Hole	Field No.	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	pH
G-5383	23A-1	1	0.0- 1.0							330		400000	
5384		2	1.0- 2.0							14		75000	
5385		3	2.0- 3.0							320		430000	
5386		4	3.0- 5.0							420		440000	
5387		5	5.0- 8.0	5.0	13	33	71	46	<0.1	450	1.3	360000	6.0
5388		6	8.0-10.0							540		460000	
5389		7	10.0-12.0							53		50000	
5390		8	12.0-14.0							8.6		6300	
5391		9	14.0-16.0							16		6400	
5392		10	16.0-18.0							7.1		1500	
5393		11	18.0-23.0							4.5		590	
5394		12	23.0-26.0							5.9		460	
5395		13	26.0-29.0							7.1		47	
5402	23A-2	2	0.7- 2.0							28		14000	
5403		3	2.0- 5.0							21		10000	
5404	23A-3	1	0.0- 1.0							28		4800	
5407	23A-4	1	0.0- 0.3	0.7	8.3	650	35	24	<0.1	570	0.3	17000	6.49
5411		5	5.5- 8.5							40		6000	
5412		6	8.5-10.0							6.4		1600	
5415	23A-5	3	2.2- 5.0							6.0		1200	
5417	23A-6	1	0.0- 1.0							7.2		99	
5419		3	2.0- 3.0							10		13	
5421	23A-7	1	0.0- 1.0							4.5		120	
5422		2	1.0- 2.0							11		360	
5427	23A-8	1	0.0- 1.0	1.3	8.7	37	4.0	15	<0.1	110	<0.1	38000	6.20
5428		2	1.0- 2.0							8.6		890	
5429	23A-9	1	0.0- 1.0							520		2200	
5430		2	1.0- 2.0							16		550	
5437	23A-10	1	0.0- 1.0							21		3000	
5438		2	1.0- 2.0							6.6		27	
5441	23A-11	1	0.0- 1.0							14		860	
5442		2	1.0- 2.0							10		170	

Results of Chemical Analysis of Soil[1]

SWD Lab No	Site Hole	Field No.	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	pH
G-5446	23A-12	1	0.0- 1.0							9.6		30	
5451	23A-13	2	1.0- 2.0							22		4700	
5452		3	2.0- 4.0							16		4000	
5453		4	4.0- 6.0							7.6		1300	
5454	23A-14	1	0.0- 1.0							9.0		79	
5455		2	1.0- 2.0							9.0		480	
5460	23A-15	1	0.0- 0.3							14		3200	
5462	23A-16	1	0.0- 0.6	1.4	11	1700	45	42	45	770	<0.1	57000	6.91
5464		3	3.0- 6.0	2.2	13	72	26	23	26	540	0.2	260000	6.11
5466		5	11.0-12.0	<0.5	1.3	27	1.1	3.9	1.1	4.8	<0.1	51000	6.20
5469	23A-17	3	8.0- 9.0							4.8		1800	
5471	23A-18	2	7.5- 9.0							8.4		2900	
5473	23A-19	2	7.0- 9.0							27		13000	
5474	23A-20	1	0.0- 1.0							42		880	
5475		2	1.0- 3.0							5.5		120	
5476		3	3.0- 5.0							5.0		84	
5477	23A-21	1	0.0- 1.0	3.1	15	94	16	12	16	3500	1.1	600000	7.21
Minimum Reported Concentration				0.5	1.0	20.0	0.5	5.0	0.1	1.0	0.1	1.0	

(1) Results reported in mg/kg.

Results of Chemical Analysis of Water[1]

SWD Lab No	Site Hole	Field No.	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	pH
5292	23-?	WS-1	Pond	<0.01	<0.001	0.29	0.005	<0.01	<0.0001	0.02	<0.004	1.08	6.70
5400	23-1	WS-1	2.6-	<0.01	0.002	1.62	0.130	<0.01	<0.0001	0.05	<0.004	1.18	7.31
5416	23A-5	WS-1	0.0-			<0.5	0.35			0.03		1.28	
5445	23A-11	WS-1	Stream			<0.5	<0.002			0.02		0.61	
Minimum Reported Concentration				0.01	0.001	0.5	0.002	0.01	0.0001	0.01	0.004	0.01	

(1) Results reported in mg/l.

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13736-1 **(** 2 **pages)**

PROJECT: Pine Bluff Arsenal
Feature: Close Hazardous Waste Site 23

Contract No.:

TEST REQUEST NO.: Telephone
Dated: 16 March 1984
Received:

From: Chief
Geotechnical Branch
Tulsa District

MATERIAL: Soil
No. and type of samples: 2 soil samples
Source or other identification: Holes 23A-16

Date received: 19 March 84

REMARKS:

Results of Tests of Soil for EP Toxicity — Table 1

Report sent to:

Tulsa District

Copy furnished:

Date: 5 May 1984

Name and title:
ARTHUR H. FEESE
Director
SWD Laboratory

Signature

Table 1

Pine Bluff Arsenal
Site 23

Results of Chemical Analysis of Soil (1)

SWD Lab No	Site Hole	Field No.	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	pH
5462	23A-16	1	0.0- 0.6	<0.01	<0.001	0.13	0.005	<0.01	<0.0001	0.02	<0.004		
5464	23A-16	3	3.0- 6.0	<0.01	<0.001	0.36	0.20	<0.01	<0.0001	0.06	<0.004		
Minimum reported concentration				0.01	0.001	0.5	0.002	0.01	0.0001	0.01	0.004		
EP Toxicity Limits				5.0	5.0	100.0	1.0	5.0	0.2	5.0	1.0		

(1) Results reported in mg/l.

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13736-2 **(** 8 **pages)**

PROJECT: Pine Bluff Arsenal
Feature: Close Hazardous Waste Site 23A

Contract No.:

TEST REQUEST NO. Telephone
Dated: 16 Mar 84
Received:

From: Chief
Geotechnical Branch
Tulsa District

MATERIAL: Disturbed Soil Samples
No. and type of samples: 16 jar samples
Source or other identification: Borings: 1 thru 4
6 thru 9, 13, 18, 20.

Date received: 1 Mar 1984

REMARKS:

Results of Tests	Table 1
Gradaction Curves	Plates 1-6

Advance data sent 3 April 84.

Report sent to:

Tulsa District

Copy furnished:

Date:
5 May 1984

Name and title:
ARTHUR H. FEESE
Director
SWD Laboratory

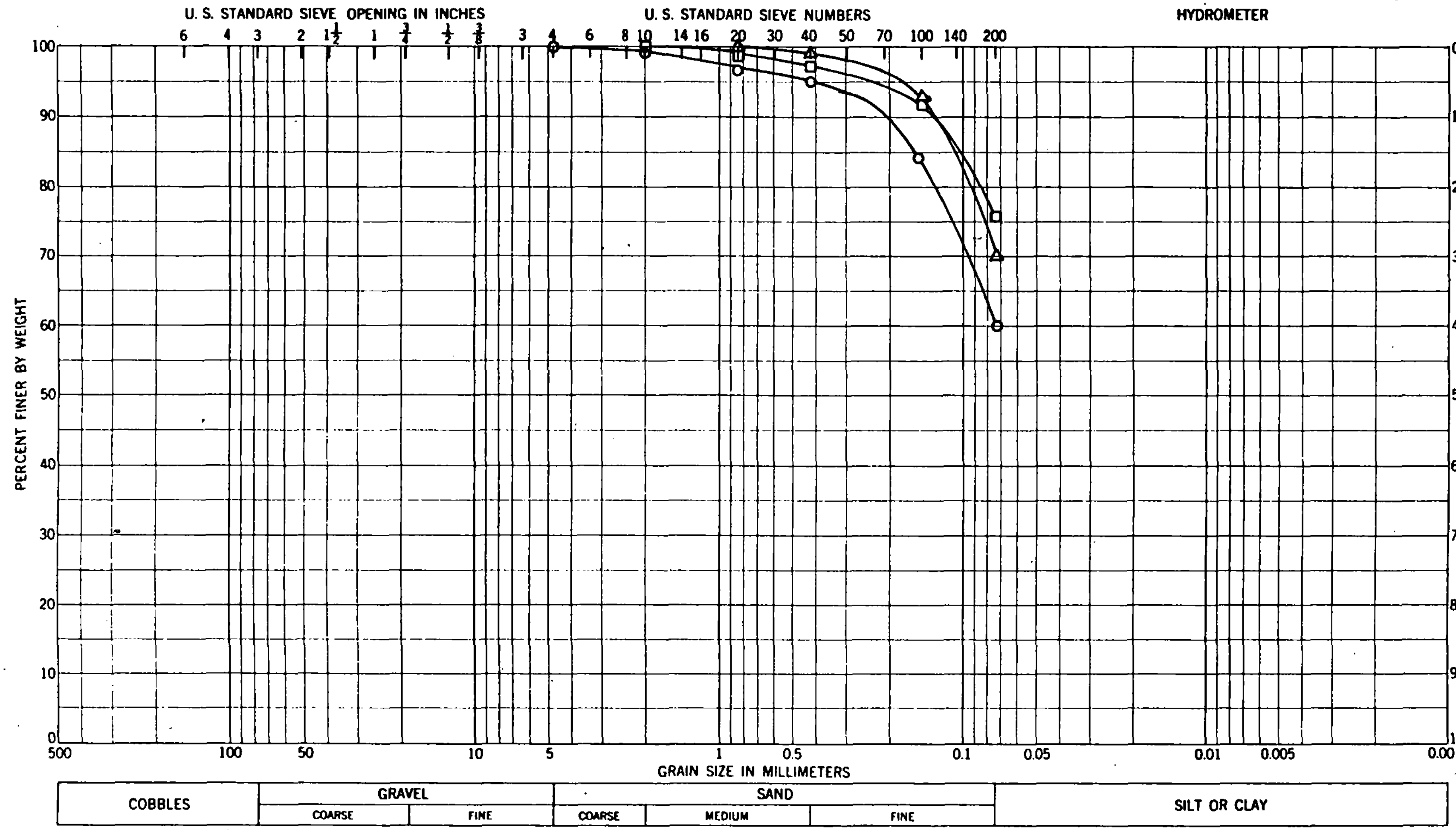
Signature

SWD FORM 896
8 SEP 77

Table 1

Results of Tests of Disturbed Soil Samples

Boring No.	Field No.	SWD No.	Depth ft.	Mechanical Analysis Gr	Sa	Fi	Atterberg Limits LL	PL	PI	LS	Water Content %		Description
23A-1	J-7	G-5389	10.0-12.0	0	40	60	NP	NP	NP	3	26.0	ML	SILT, sandy, light gray, wet.
	J-10	5392	16.0-18.0	0	30	70	23	16	7		19.5	CL-ML	CLAY, sandy, gray, moist.
	J-12	5394	23.0-26.0	0	24	76	36	15	21		21.2	CL	CLAY, sandy, gray, moist.
23A-2	J-3	5403	2.0- 5.0	0	23	77	26	19	7		18.2	CL-ML	CLAY, sandy, gray, very moist.
23A-3	J-1	5404	0.0- 1.0	3	33	64	30	19	11		27.6	CL	CLAY, sandy, gray, very moist.
23A-4	J-5	5411	5.5- 8.5	0	61	39	NP	NP	NP	2	17.9	SM	SAND, silty, light gray and yellow, moist.
23A-6	J-1	5417	0.0- 1.0	0	16	84	25	17	8		16.1	CL	CLAY, gray, damp.
	J-3	5419	1.0- 2.0								-	ML	SILT, light brown, damp.
23A-7	J-1	5421	0.0- 1.0								-	ML	SILT, gray, moist.
	J-2	5422	1.0- 2.0								-	ML	SILT, gray, moist.
23A-8	J-2	5428	1.0- 2.0								-	ML	SILT, gray brown, moist.
23A-9	J-1	5432	0.0- 1.0								-	ML	SILT, gray, moist.
	J-2	5433	1.0- 2.0								-	ML	SILT, gray, moist.
23A-13	J-2	5451	1.0- 2.0	1	28	71	21	17	4		15.0	ML-CL	SILT, sandy, gray brown, moist.
23A-18	J-2	5471	7.5- 9.0								-	ML	SILT, sandy, light gray brown, wet.
23A-20	J-2	5475	1.0- 3.0								-	ML	SILT, sandy, gray, moist.



Sample No.		Elev or Depth	Classification	Nat w %	LL	PL	PI
G-5389	O	10.0-12.0	SILT, sandy (ML)	26.0	NP	NP	NP
G-5392	Δ	16.0-18.0	CLAY, sandy (CL-ML)	19.5	23	16	7
G-5394	□	23.0-26.0	CLAY, sandy (CL)	21.2	36	15	21

Project Pine Bluff Arsenal

Area

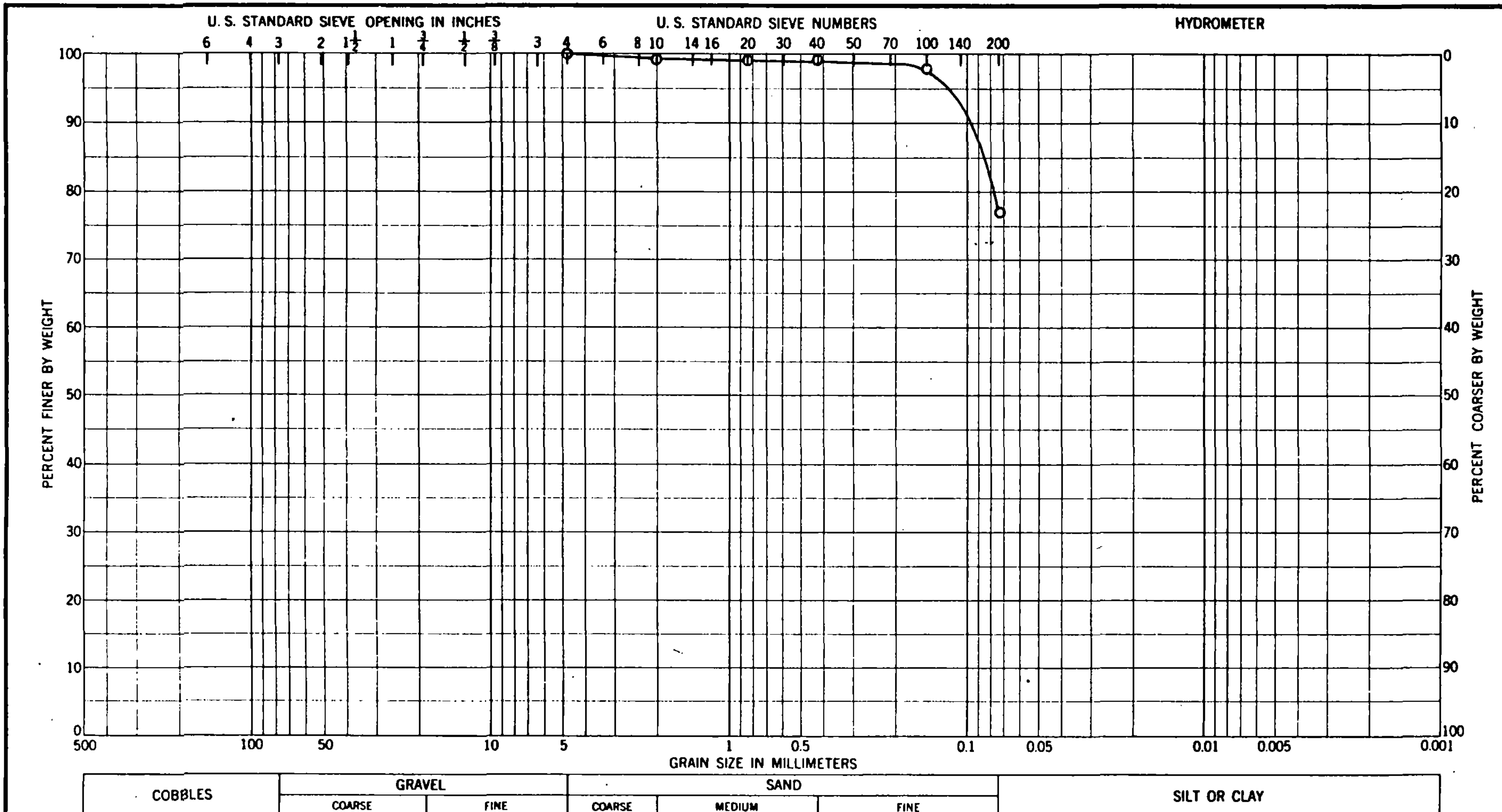
Boring No. 23A-1

Date April 84

GRADATION CURVES

ENG FORM 1 MAY 63 2087

SWDED-GL Report No. 13736-2



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
G-5403	2.0-5.0	CLAY, sandy (CL-ML)	18.2	26	19	7

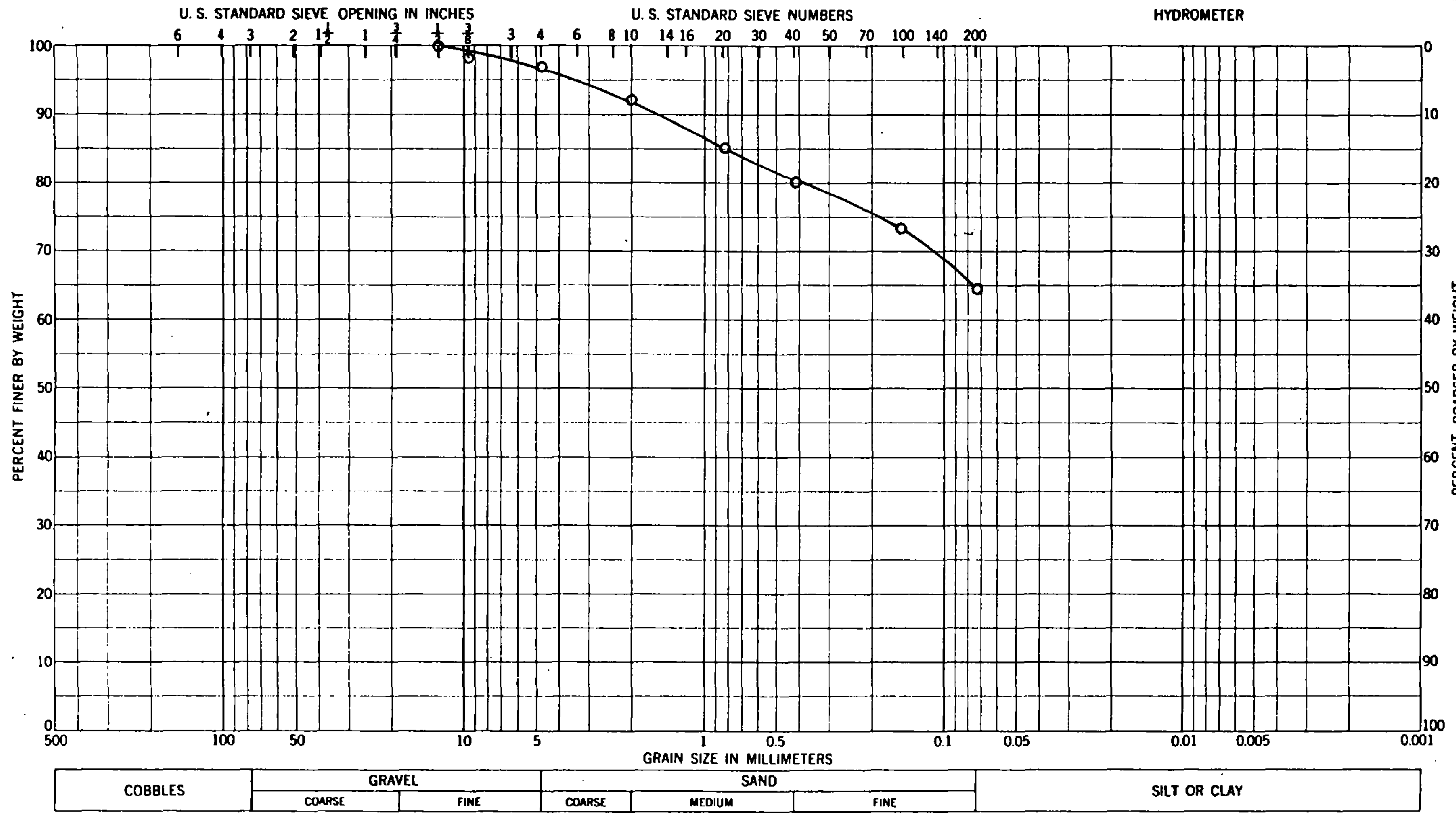
Project	Pine Bluff Arsenal
Area	
Boring No.	23A-2
Date	April 84

GRADATION CURVES

ENG FORM 1 MAY 63 2087

SWDED-GL Report No. 13736-2

Plate 2



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
G-5404	0.0-1.0	CLAY, sandy (CL)	27.6	30	19	11

Project Pine Bluff Arsenal

Area

Boring No. 23A-3

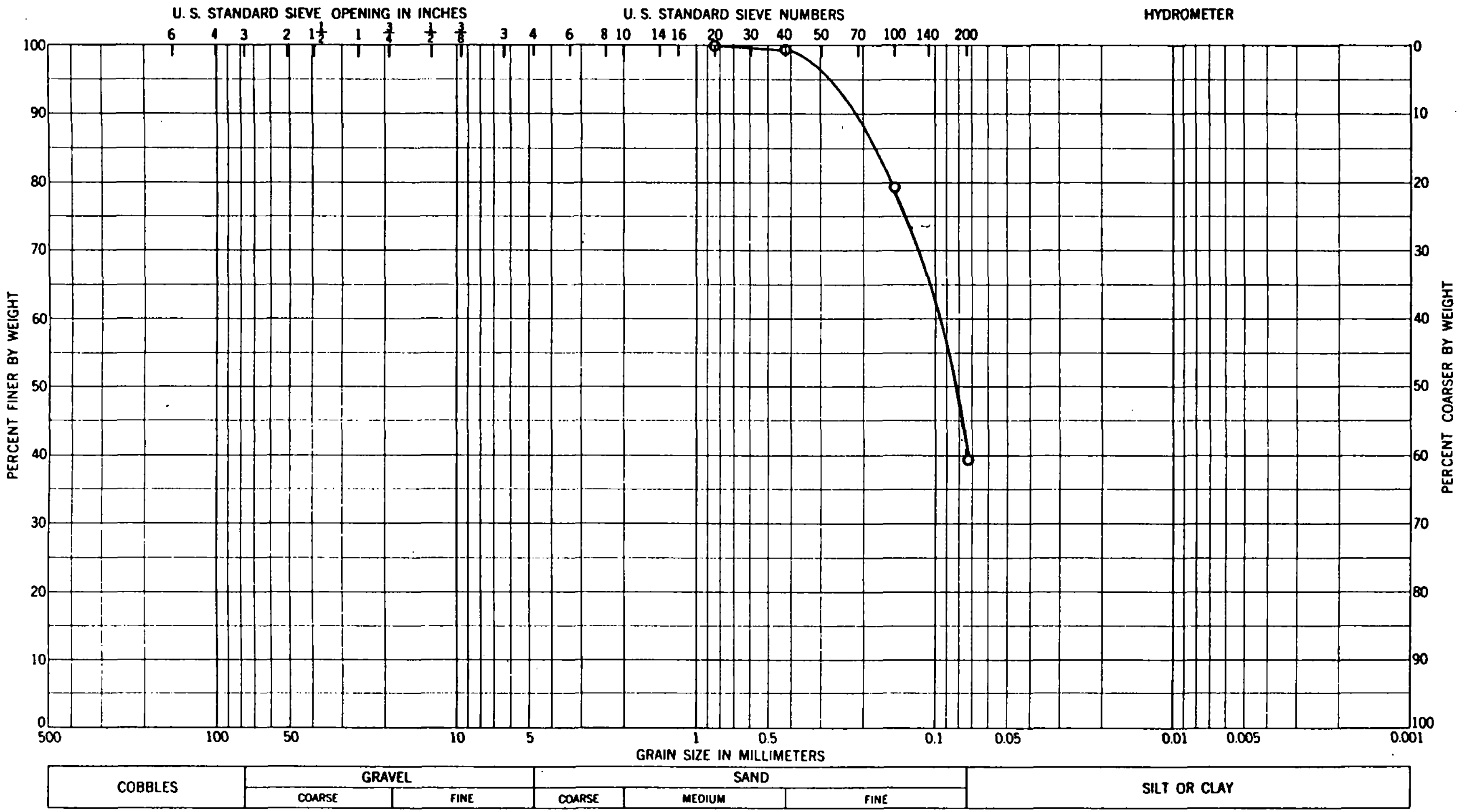
Date April 84

GRADATION CURVES

ENG FORM 1 MAY 63 2087

Plate 3

SWDED-GL Report No. 13736-2



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
G-5411	5.5-8.5	SAND, silty (SM)	17.9	NP	NP	NP

Project Pine Bluff Arsenal

Area

Boring No. 23A-4

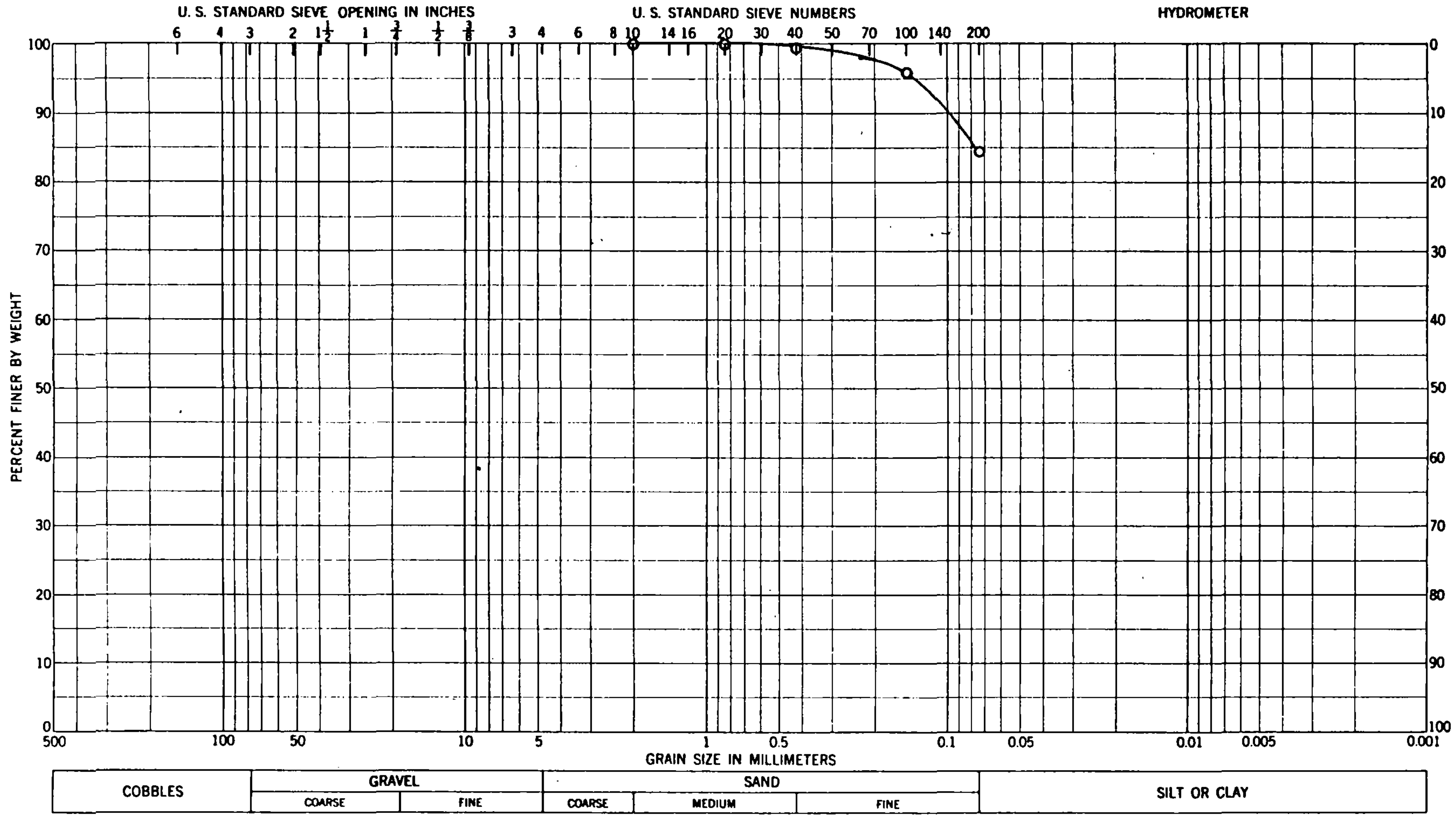
Date April 84

GRADATION CURVES

ENG FORM 1 MAY 63 2087

SWDED-GL Report No. 13736-2

Plate 4



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
G-5417	0.0-1.0	CLAY (CL)	16.1	25	17	8

Project Pine Bluff Arsenal

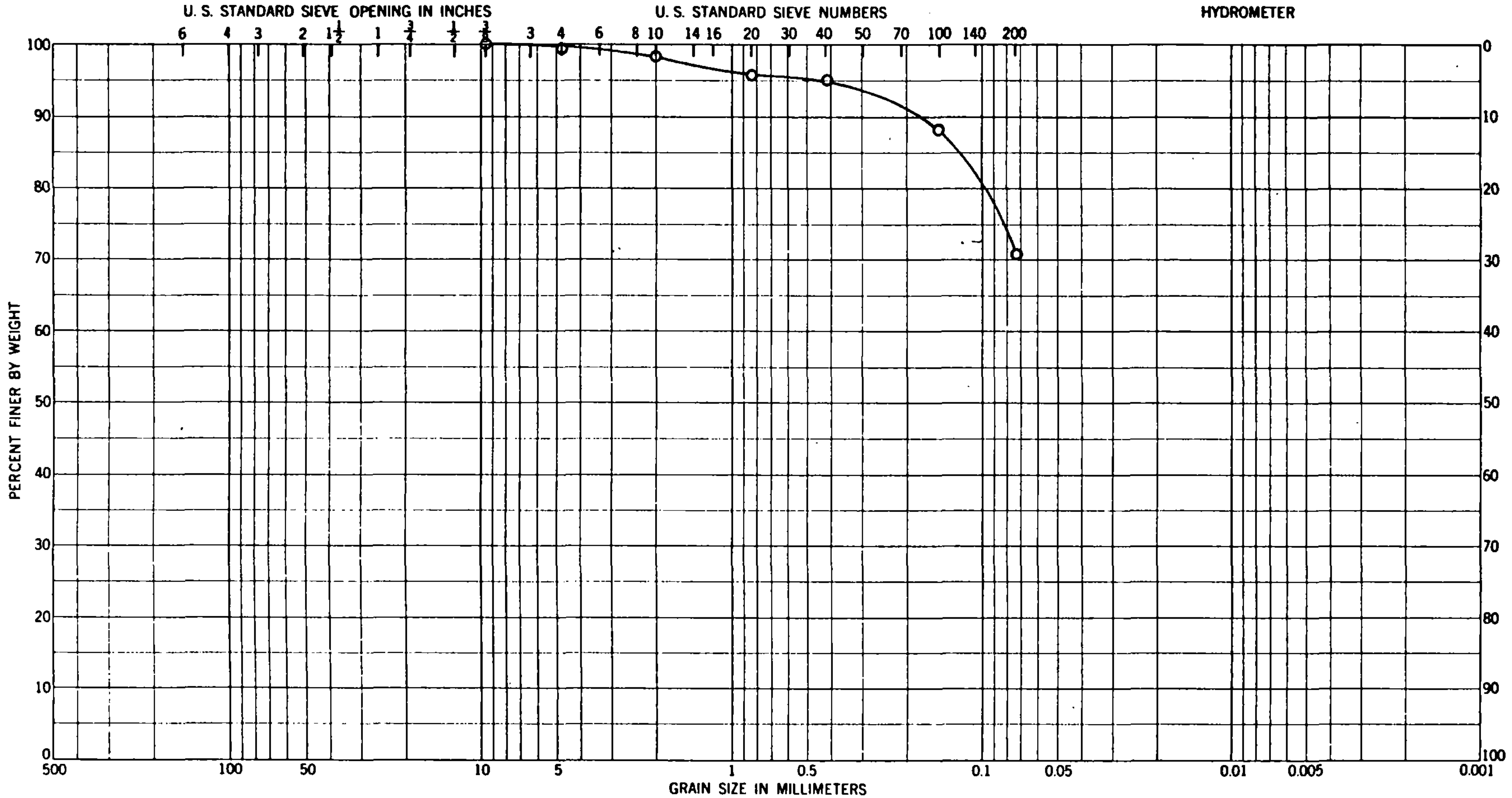
Area

Boring No. 23A-6

Date April 84

GRADATION CURVES

ENG FORM 1 MAY 63 2087



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
G-5451	1.0-2.0	SILT, sandy (ML-CL)	15.0	21	17	4

Project Pine Bluff Arsenal

Area

Boring No. 23A-13

Date April 84

GRADATION CURVES

ENG FORM 1 MAY 63 2087

Plate 6

SWDED-GL Report No. 13736-2

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13736-3 **(** 2 **pages)**

PROJECT: Pine Bluff Arsenal
Feature: Close Hazardous Waste Size 23

Contract No.:

TEST REQUEST NO.: Telephone
Dated: 3 May 84
Received:

From: Chief
Geotech Branch
Tulsa District

MATERIAL: Soil
No. and type of samples: 11 jar samples
Source or other identification: Holes: 23-24 thru 23-26A

Date received: 1 May 84

REMARKS:

Results of Chemical Analysis of Soil — Table 1

Results of tests telephone to TDO on 11 May 84

Report sent to:

Tulsa District

Copy furnished:

Date:	**Name and title:**	**Signature**
13 Jun 84	ARTHUR H. FEESE Director SWD Laboratory	

SWD FORM 896
8 SEP 77

SWDED-GL Report 13736-3

Table 1

Pine Bluff Arsenal
Site 23

Results of Chemical Analysis of Soil (1)

SWD Lab No	Site Hole	Field No.	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn
6523	23-24	1	0.0-1.1			38				7.5		45
6524		2	1.1-2.1			29				12		12
6525		3	2.1-3.1			39				8.8		6.7
6526		4	3.1-6.6			48				9.2		6.3
6527		5	6.6-10.0			23				4.2		36
6528	23-25	1	0.0-1.0			200				9.6		440
6529		2	1.0-2.0			85				8.9		450
6532	23-25A	1	1.0-3.4			88				17		1400
6533	23-26	1	0.0-1.0			61				3.8		66
6534		2	1.0-2.0			72				10		32
6538	23-26A	1	1.3-3.4			38				16		920
Minimum reported concentration						20.0				1.0		1.0

(1) Results reported in mg/kg

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13736-4 **(** 2 **pages)**

PROJECT: Pine Bluff Arsenal
Feature: Close Hazardous Waste Site 23

Contract No.:

TEST REQUEST NO.: Telephone
Dated: 29 May 84
Received:

From: Chief
Geotechnical Branch
Tulsa District

MATERIAL: Soil
No. and type of samples: 9 jar samples
Source or other identification: Holes: 3, 5, 6, 14, and 15

Date received: 19 March 84

REMARKS:

Results of Chemical Analysis of Soil Samples Table 1

Results telephoned to TDO on 7 June 84.

Report sent to:

Tulsa District

Copy furnished:

Date:

17 Aug 84

Name and title:
ARTHUR H. FEESE
Director
SWD Laboratory

Signature

SWD FORM 896
8 SEP 77

SWDED-GL Report 13736-4

Table 1

Pine Bluff Arsenal
Site 23

Results of Chemical Analysis of Soil(1)

Hole	Field No.	SWD No.	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	
23-3	J-2	5405	1.0- 3.0							11		220	
	J-3	5406	3.0- 5.0							3.6		5.6	
23-5	J-1	5413	0.0- 0.5							25		8200	
	J-2	5414	0.5- 2.2							2900		460000	
23-6	J-2	5418	1.0- 2.0							7.6		48	
	J-4	5420	3.0- 5.0							7.2		< 1.0	
23-14	J-1	5454	0.0- 1.0							11		110	
	J-3	5456	2.0- 3.0							5.7		24	
23-15	J-2	5461	0.3- 2.0							10		170	
	J-3		Not received										
Minimum reported concentration				0.5	1.0	20.0	0.5	5.0	0.1	1.0	0.1	1.0	

(1) Results reported in mg/kg

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13736-5 **(** 3 **pages)**

PROJECT: Pine Bluff Arsenal **Feature:** Close Hazardous Waste Site 23	**Contract No.:**
TEST REQUEST NO.: Telephone **Dated:** 7 May 84 **Received:**	**From:** Chief Geotechnical Branch Tulsa District

MATERIAL: Soil
No. and type of samples: 19 soil and 1 water samples
Source or other identification: Holes: 23A-1, -3 thru -8, and -20

Date received: 19 March 1984

REMARKS:

Results of Chemical Analysis of Soil Samples	Table 1
Results of Chemical Analysis of Water Samples	Table 2

Results of tests telephoned to TDO on 21 June 84.

Report sent to: Tulsa District	**Copy furnished:**

Date:	**Name and title:**	**Signature**
18 August 84	ARTHUR H. FEESE Director SWD Laboratory	

SWD FORM 896
8 SEP 77

Table 1

Results of Chemical Analysis of Soil(1)

Hole	Field No.	SWD No.	Depth	Hexachloroethane
23A-1	J-1	5383	0.0- 1.0	19,000
	J-3	5385	2.0- 3.0	220,000
	J-5	5387	5.0- 8.0	200,000
	J-7	5389	10.0-12.0	22,000
	J-9	5391	14.0-16.0	620
23A-3	J-2	5405	1.0- 3.0	0.3
23A-4	J-2	5408	0.3- 1.0	160,000
	J-4	5410	3.0- 5.5	240,000
	J-6	5412	8.5-10.5	15
23A-5	J-2	5414	0.5- 2.2	24,000
23A-6	J-1	5417	0.0- 1.0	1.1
	J-2	5418	1.0- 2.0	0.4
23A-7	J-1	5421	0.0- 1.0	3.6
	J-3	5423	2.0- 3.0	1.0
	J-6	5426	7.0-10.0	0.3
23A-8	J-1	5427	0.0- 1.0	0.4
	J-3	5429	2.0- 3.0	0.3
23A-20	J-1	5474	0.0- 1.0	0.2
	J-3	5476	3.0- 5.0	0.6
Minimum Reported Concentration				0.1

(1) Results reported in mg/kg.

Table 2

Results of Chemical Analysis of Water(1)

Hole	Field No.	SWD No.	Depth	Hexachloroethane
23A-1	WS-1	5400	2.6 -	0.45
Minimum Reported Concentration				0.05

(1) Results reported in mg/l.

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13736-6 (4 pages)

PROJECT: Pine Bluff Arsenal
Feature: Closed Hazardous Waste Site 23A

Contract No.:

TEST REQUEST NO.: Telephone
Dated: 17 July 84
Received:

From: Chief
Geotechnical Branch
Tulsa District

MATERIAL: Disturbed and Undisturbed soil samples
No. and type of samples: 24 jar and 2 denison samples
Source or other identification: Borings 22, 23, 193 and 195

Date received: 15 May 84, 21 June 84 and 28 June 84

REMARKS:

Results of Tests Table 1

Advance Data Sent 31 July 84

Report sent to:
Tulsa District

Copy furnished:

Date: 8-21-84

Name and title:
ARTHUR H. FEESE
Director
SWD Laboratory

Signature

SWD FORM 896
8 SEP 77

SWDED-GL Report 13736-6

Table 1

Pine Bluff Arsenal - Site 23A

Results of Tests of Disturbed and Undisturbed Soil Samples

Boring No.	Field No.	SWD No.	Depth ft.	Mechanical Analysis Gr	Sa	Fi	Atterberg Limits LL	PL	PI	LS	Water Content %	Dry Density lb/cu ft	Test Type	Plate		Description
22	J-1	6/6842	0.0-3.0	0	5	95	39	18	21	11	19.7				CL	CLAY, gray, moist.
	J-3	6844	6.0-9.0	0	7	93	24	20	4	3	12.9				ML-CL	SILT, yellow brown, damp
	J-5	6846	12.0-15.0	0	77	23	20	12	8	5	5.7				SC	SAND, clayey, yellow brown, moist.
	J-7	6848	18.0-20.0	0	64	36	22	15	7	8	7.0				SC-SM	SAND, clayey, yellow brown, moist.
	J-9	6850	23.0-26.5	0	6	94	56	19	37	18	22.6				CH	CLAY, gray, moist.
23	J-1	6881	0.0-3.0												ML	SILT, gray, very moist.
	J-2	6882	3.0-6.0												ML	SILT, light gray, damp.
	J-3	6883	6.0-9.0												ML	SILT, light gray, moist.
	J-4	6884	9.0-12.5												SC	SAND, clayey, gray brown, moist.

* Actual length of sample in feet

SWDED-GL Report

Table

Boring No.	Field No.	SWD No.	Depth ft.	Mechanical Analysis Gr	Mechanical Analysis Sa	Mechanical Analysis Fi	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Atterberg Limits LS	Water Content %	Dry Density lb/cu ft	Test Type	Test Plate		Description
23	J-5	6/6885	12.5-15.5												ML	SILT, light gray, moist,
	J-6	/6886	15.5-17.2												ML	SILT, light gray, moist,
	J-7	/6887	17.2-18.0	0	19	81	38	15	23	B	20.2				CL	CLAY, gray, moist,
	DB-1	84/3750	18.0-20.0 1.7*								19.1	108			CL	CLAY, gray, moist, medium consistency, slightly sandy.
			Falling Head Permeability = 1.5 × 10^{-9} cm/sec.													
	J-8	6/6888	20.0-20.5	0	43	57	26	16	10	6	17.1				CL	CLAY, sandy, gray, moist,
	J-9	/6889	22.5-23.0	0	45	55	26	15	11	5	16.5				CL	CLAY, sandy, gray, moist.
	DB-3	84/3752	23.0-24.8 1.6*								20.3	108			CL	CLAY, sandy, gray, moist, very stiff.
			Falling Head Permeability = 3.9 x10^{-9} cm/sec.													
	J-10	6/6890	24.8-25.3	0	38	62	22	17	5	3	15.9				ML-CL	SILT, sandy, gray, moist,

* Actual length of sample in feet

SWDED-GL Report

Table

Boring No.	Field No.	SWD No.	Depth ft.	Mechanical Analysis Gr	Sa	Fi	Atterberg Limits LL	PL	PI	LS	Water Content %	Dry Density lb/cu ft	Test Type	Plate		Description
193	J-7	6/6860	18.0-21.0	0	16	84	34	15	19	12	22.6				CL	CLAY, gray, moist.
	J-9	/6862	25.0-28.0	0	40	60	20	16	4	4	17.3				ML-CL	SILT, sandy, gray, moist.
	J-10	/6891	28.0-30.0	0	37	63	NP	NP	NP	3	18.3				ML	SILT, sandy, gray, moist.
	J-15	/6896	42.0-47.0	0	83	17	NP	NP	NP	0	21.4				SM	SAND, silty, gray, wet.
195	J-8	/6870	21.0-23.0	0	62	38	NP	NP	NP	3	8.1				SM	SAND, silty, gray, moist.
	J-9	/6871	23.0-26.0	0	10	90	37	15	22	12	19.9				CL	CLAY, gray, moist.
	J-11	/6873	29.0-32.0	0	7	93	39	18	21	10	23.4				CL	CLAY, gray, moist.
	J-12	/6874	32.0-35.0	0	1	99	72	27	45	19	33.4				CH	CLAY, light gray, moist.
	J-15	/6877	42.0-45.0	0	84	16	NP	NP	NP	0	21.1				SM	SAND, silty, gray, wet.

* Actual length of sample in feet

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13736-7 **(2 pages)**

PROJECT: Pine Bluff Arsenal
Feature: Close Hazardous Waste Site 23A

Contract No.:

TEST REQUEST NO.: Telephone
Dated: 17 July 84
Received:

From: Chief
Geotech Branch
Tulsa District

MATERIAL: Soil
No. and type of samples: 11 jar samples
Source or other identification: Borings: 22,23, and 27

Date received: 15 May, 21 June 84

REMARKS:

Results of Chemical Analysis of Soil Samples — Table 1

Results of tests telephoned to TDO on 31 July 84

Report sent to:

Copy furnished:

Date: 10 Sep 84

Name and title:
ARTHUR H. FEESE
Director
SWD Laboratory

Signature

SWD FORM 896
8 SEP 77

Table 1

Pine Bluff Arsenal
Site 23A

Results of Chemical Analysis of Soil(1)

SWD Lab No	Site Hole	Field No.	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	pH
6842	23A-22	J-1	0.0-3.0	<0.5	1.2	24	<0.5	8.3	<0.1	11	<0.1	9.7	
6844		J-3	6.0-9.0	<0.5	<1.0	<20	<0.5	<5.0	<0.1	8.2	<0.1	3.1	
6846		J-5	12.0-15.0	<0.5	<1.0	<20	<0.5	<5.0	<0.1	8.9	<0.1	3.7	
6848		J-7	18.0-20.0	<0.5	<1.0	55	<0.5	<5.0	<0.1	3.6	<0.1	<1.0	
6850		J-9	23.0-26.5	<0.5	<1.0	<20	<0.5	<5.0	<0.1	11	<0.1	1.9	
6881	23A-23	J-1	0.0-3.0						<0.1	6.4			
6882		J-2	3.0-6.0						<0.1	3.7			
6839	23A-27	J-1	0.0-1.0			200				180		6500	
6840		J-2	1.0-2.0			23				38		6100	
6841		J-3	2.0-3.0			<20				9.5		1000	
6852		J-4	3.0-5.0			<20				4.6		550	
Minimum Reported Concentration				0.5	1.0	20.0	0.5	5.0	0.1	1.0	0.1	1.0	

(1) Results reported in mg/kg

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13736-8 **(** 2 **pages)**

PROJECT: Pine Bluff Arsenal
Feature: Close Hazardous Waste Site 23A

Contract No.:

TEST REQUEST NO.: Telephone
Dated: 17 Jul 84
Received:

From: Chief
Geotechnical Branch
Tulsa District

MATERIAL: Water
No. and type of samples: 1 jar
Source or other identification: Hole 28

Date received: 17 July 84

REMARKS:

Results of Chemical Analysis of Water Samples — Table 1

Results of tests telephoned to TDO on 29 Aug 84

Report sent to:
Tulsa District

Copy furnished:

Date: 10 Sep 84

Name and title:
ARTHUR H. FEESE
Director
SWD Laboratory

Signature

SWD FORM 896
8 SEP 77

SWDED-GL Report 13736-8

Table 1

Pine Bluff Arsenal
Site 23A

Results of Chemical Analysis of Water (1)

Hole	Field No.	SWD No.	Depth	Hexachloroethane
23A-28	WS-1	7180	Unknown	0.00006

Minimum Reported Concentration 0.00002

(1) Results reported in mg/l

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13736-9 **(2 pages)**

PROJECT: Pine Bluff Arsenal
Feature: Close Hazardous Waste Site 23A

Contract No.:

TEST REQUEST NO.: Telephone
Dated: 13 Dec 84
Received:

From: Chief
Geotechnical Branch
Tulsa District

MATERIAL: Soil
No. and type of samples: 13 Soil Samples
Source or other identification: Holes: 1, 4, 8, 17 and 23

Date received: 19 March, 21 June 84

REMARKS:

Results of Chemical Analysis of Soil Samples — Table 1

Results of tests telephoned to TDO on 4 Jan 85

Report sent to:
Tulsa District Office

Copy furnished:

Date:
08 Jan 85

Name and title:
ARTHUR H. FEESE
Director
SWD Laboratory

Signature

SWD FORM 806
8 SEP 77

Results of Chemical Analysis of Soil[1]

Hole	Field No.	SWD No.	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	
1	J- 7	G/ 5389	10.0-12.0	<0.5	9.1	<20	10	6.4			0.1		
	J- 8	5390	12.0-14.0	<0.5	<1.0	<20	1.0	<5.0			<0.1		
	J-10	5392	16.0-18.0	<0.5	<1.0	<20	2.7	<5.0			<0.1		
	J-12	5394	23.0-26.0	<0.5	<1.0	<20	<0.5	<5.0			<0.1		
4	J- 4	5410	3.0- 5.5	2.5	9.2	<20	41	34			0.1		
	J- 5	5411	5.5- 8.5	<0.5	6.0	<20	3.7	<5.0			<0.1		
	J- 6	5412	8.5-10.0	<0.5	1.0	<20	0.7	<5.0			<0.1		
8	J- 3	5429	2.0- 3.0	<0.5	<1.0	32	<0.5	<5.0			<0.1		
	J- 5	5431	4.0- 5.0	<0.5	1.6	20	<0.5	<5.0			<0.1		
17	J- 2	5468	2.0- 8.0	0.7	29	<20	5.2	17			0.1		
	J- 3	5469	8.0- 9.0	<0.5	<1.0	<20	0.9	<5.0			<0.1		
23	J- 1	6881	0.0- 3.0			<20	<0.5			7.8			
	J- 3	6883	6.0- 9.0			<20	<0.5			4.0			
Minimum reported concentration				0.5	1.0	20.0	0.5	5.0	0.1	1.0	0.1	1.0	

(1) Results reported in mg/kg

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13736-10 **(** 2 **pages)**

PROJECT: Pine Bluff Arsenal **Feature:** Close Hazardous Waste Site 23A	**Contract No.:**
TEST REQUEST NO.: Telephone **Dated:** 4 Jan 85 **Received:**	**From:** Chief Geotechnical Branch Tulsa District

MATERIAL: Water
No. and type of samples: 2 jars
Source or other identification: Holes: 5 and 11

Date received: 19 Mar 84

REMARKS:

Results of Chemical Analysis of Water Samples

Results of tests telephoned to TDO on 11 Jan 85

Report sent to: Tulsa District Office	**Copy furnished:**

Date: 19 Feb 85	**Name and title:** **ARTHUR H. FEESE** **Director** **SWD Laboratory**	**Signature**

SWD FORM 896
8 SEP 77

SWDED-GL Report 13736-10 **Table** **Pine Bluff Arsenal**
Site 23A

Results of Chemical Analysis of Water[1]

Hole	Field No.	SWD No.	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	
5	WS-1	5416				<0.50	0.350						
11	WS-1	5445				<0.50	<0.002						
Minimum Reported Concentration				0.01	0.001	0.50	0.002	0.01	0.0001	0.01	0.0004	0.01	

(1) Results reported in mg/l.

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13736-11 **(3 pages)**

PROJECT: Pine Bluff Arsenal
Feature: Closed Hazardous Waste Site 23A

Contract No.:

TEST REQUEST NO.: Telephone
Dated: 15 Jan 85
Received:

From: Chief
Geotechnical Branch
Tulsa District

MATERIAL: Disturbed Soil Samples.
No. and type of samples: 36 jar samples
Source or other identification: Borings: 28,29,31,32,33,35.

Date received: 29 Jan 85

REMARKS:

Results of Tests — Table 1

Advance data sent 2 Mar 85.

Report sent to:
Tulsa District

Copy furnished:

Date: 08 Mar 85

Name and title:
ARTHUR H. FEESE
Director
SWD Laboratory

Signature

SWD FORM 896
8 SEP 77

BORING NO.	FLD NO.	SWD NO.	DEPTH, FT.	GR	SA	FI	LL	PL	PI	LS	WC, %	PCF	MAJOR TESTS	DESCRIPTION OF MATERIAL
														PINE BLUFF ARSENAL - CLOSED HAZARDOUS WASTE SITE 23A
28	J-2	6-8416	0.8-3.0	0	21	79	NP	NP	NP	3	13.1			ML - SILT WITH SAND, GRAY, MOIST.
28	J-3	6-8417	3.0-6.0	0	19	81	NP	NP	NP	1	20.4			ML - SILT WITH SAND, GRAY, VERY MOIST TO WET, SOME DECAYED WOOD NOTED.
28	J-9	6-8423	21.0-24.0	0	10	90	34	15	19	10	22.5			CL - LEAN CLAY, GRAY, MOIST.
29	J-1	6-8426	0.0-3.0	0	20	80	NP	NP	NP	2	15.3			ML - SILT WITH SAND, GRAY, MOIST.
29	J-3	6-8428	4.0-6.0	0	22	78	27	17	10	4	15.1			CL - LEAN CLAY WITH SAND, GRAY, MOIST.
29	J-5	6-8430	8.0-11.0	0	77	23	NP	NP	NP	0	19.2			SM - SILTY SAND, GRAY, VERY MOIST TO WET.
29	J-7	6-8432	14.0-16.0	0	17	83	30	17	13	6	23.8			CL - LEAN CLAY WITH SAND, LIGHT GRAY, MOIST.
29	J-8	6-8433	16.0-18.0	0	86	14	NP	NP	NP	1	16.2			SM - SILTY SAND, GRAY, VERY MOIST.
29	J-10	6-8435	21.0-24.0	0	13	87	32	12	20	10	22.7			CL - LEAN CLAY, GRAY, MOIST.
31	J-1	6-8451	0.0-3.0	0	21	79	NP	NP	NP	2	17.9			ML - SILT WITH SAND, GRAY, MOIST.
31	J-2	6-8452	3.0-6.0	0	20	80	NP	NP	NP	3	21.4			ML - SILT WITH SAND, GRAY, VERY MOIST.
31	J-3	6-8453	6.0-9.0	0	61	39	NP	NP	NP	1	13.6			SM - SILTY SAND, GRAY, MOIST.
31	J-4	6-8454	9.0-12.0	0	34	66	NP	NP	NP	1	16.7			ML - SANDY SILT, GRAY, VERY MOIST.
31	J-5	6-8455	12.0-15.0	0	73	27	NP	NP	NP	0	15.3			SM - SILTY SAND, GRAY, VERY MOIST.
31	J-6	6-8456	15.0-18.0	0	55	45	NP	NP	NP	2	16.4			SM - SILTY SAND, GRAY, MOIST.
31	J-8	6-8458	21.0-24.0	0	49	51	NP	NP	NP	0	16.0			ML - SANDY SILT, GRAY, MOIST.
31	J-9	6-8459	24.0-25.0	0	58	42	NP	NP	NP	1	15.4			SM - SILTY SAND, GRAY, MOIST.
31	J-10	6-8460	25.0-27.0	0	17	83	28	14	14	9	21.8			CL - LEAN CLAY WITH SAND, GRAY, MOIST.
32	J-1	6-8462	0.0-3.0	0	20	80	NP	NP	NP	2	23.0			ML - SILT WITH SAND, GRAY, MOIST.
32	J-2	6-8463	3.0-6.0	0	18	82	NP	NP	NP	2	16.6			ML - SILT WITH SAND, GRAY, VERY MOIST.
32	J-3	6-8464	6.0-8.0	4	39	57	NP	NP	NP	2	11.4			ML - SANDY SILT, YELLOW BROWN, MOIST.
32	J-5	6-8466	11.0-12.0	0	78	22	NP	NP	NP	1	6.2			SM - SILTY SAND, YELLOW BROWN, MOIST.
32	J-7	6-8468	15.0-18.0	0	46	54	NP	NP	NP	1	16.8			ML - SANDY SILT, GRAY, MOIST.
32	J-8	6-8469	18.0-21.0	0	29	71	28	13	15	10	16.3			CL - LEAN CLAY WITH SAND, GRAY, MOIST.

BORING NO.	FLD NO.	SWD NO.	DEPTH, FT.	GR	SA	FI	LL	PL	PI	LS	WC, %	PCF	MAJOR TESTS	DESCRIPTION OF MATERIAL
33	J-2	G-8475	3.0-6.0	0	14	86	23	17	6	4	17.6			CL-ML - SILTY CLAY, GRAY, MOIST.
33	J-4	G-8477	9.0-12.0	0	20	80	NP	NP	NP	0	18.5			ML - SILT WITH SAND, GRAY AND YELLOW BROWN, MOIST.
33	J-5	G-8478	12.0-15.0	0	20	30	28	16	12	5	20.9			CL - LEAN CLAY WITH SAND, GRAY, MOIST.
33	J-6	G-8479	15.0-18.0	0	60	40	NP	NP	NP	0	15.1			SM - SILTY SAND, GRAY, MOIST.
33	J-7	G-8480	18.0-21.0	0	62	38	NP	NP	NP	0	14.3			SM - SILTY SAND, GRAY, MOIST.
33	J-8	G-8481	21.0-24.0	0	18	82	25	14	11	4	19.3			CL - LEAN CLAY WITH SAND, GRAY, MOIST.
35	J-1	G-8497	0.0-3.0	0	21	79	NP	NP	NP	1	26.0			ML - SILT WITH SAND, GRAY, WET, SOME TINY ROOTS NOTED.
35	J-2	G-8498	3.0-6.0	0	19	81	24	15	9	4	17.5			CL - LEAN CLAY WITH SAND, GRAY BROWN, MOIST.
35	J-3	G-8499	6.0-9.0	0	28	72	NP	NP	NP	1	14.9			ML - SILT WITH SAND, GRAY, MOIST.
35	J-6	G-8502	13.5-15.0	0	46	54	NP	NP	NP	0	15.0			ML - SANDY SILT, GRAY, MOIST.
35	J-8	G-8504	18.0-20.0	0	48	52	NP	NP	NP	0	19.0			ML - SANDY SILT, GRAY, MOIST.
35	J-9	G-8505	20.0-24.0	0	17	83	32	13	19	13	21.0			CL - LEAN CLAY WITH SAND, GRAY, MOIST.

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13736-12 (7 **pages**)

PROJECT: Pine Bluff Arsenal
Feature: Closed Hazardous Waste Site 23

Contract No.:

TEST REQUEST NO.: Verbal Request
Dated: 12 Mar 85
Received:

From: Chief
Geotechnical Branch
Tulsa District

MATERIAL: Undisturbed Soil Samples
No. and type of samples: 5 Denison samples
Source or other identification: Borings 30 and 34

Date received: 24 Jan 85

REMARKS:

Results of Tests	Table 1
Triaxial Compression Tests, 1 point, Q-type	Plates 1-5

Advance data sent 26 Mar 85

Report sent to:

Tulsa District

Copy furnished:

Date:

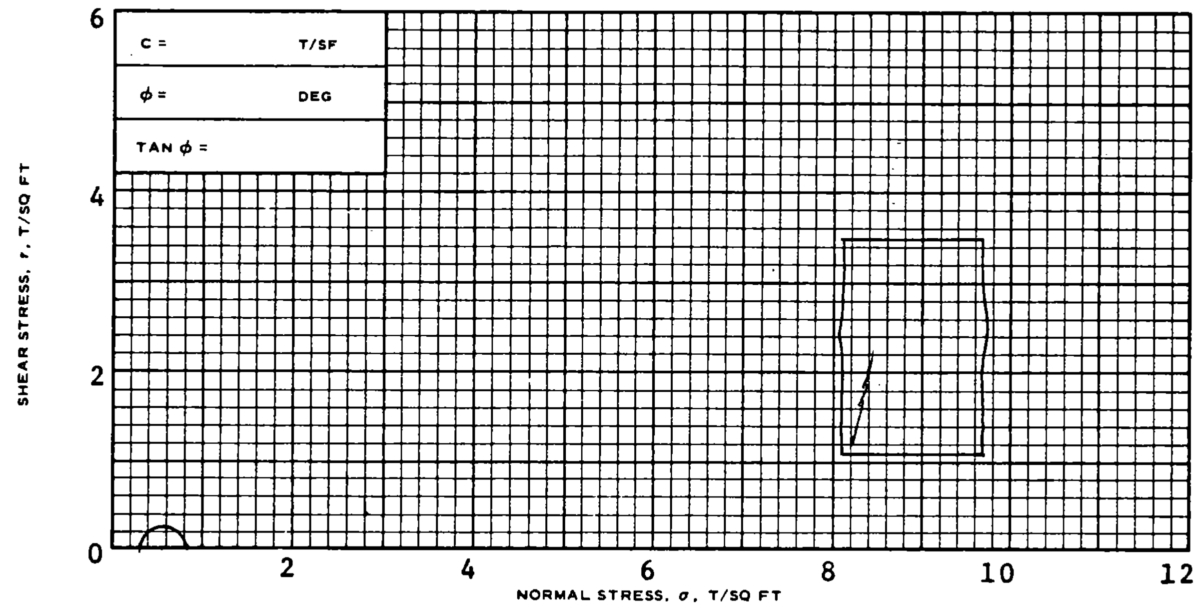
22 Apr 85

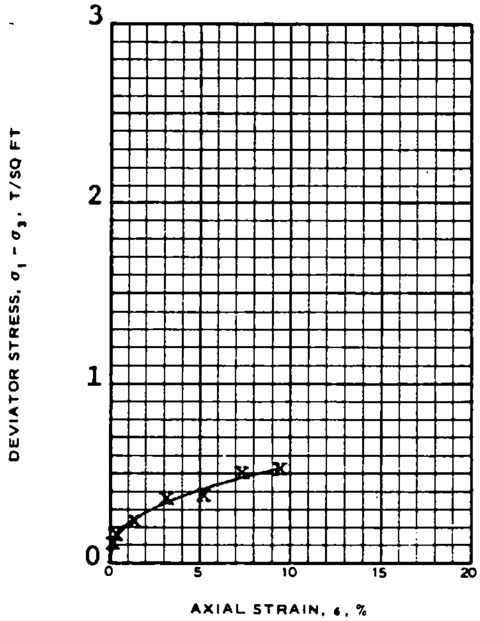
Name and title:
ARTHUR H. FEESE
Director
SWD Laboratory

Signature

SWD FORM 896
8 SEP 77

BORING NO.	FLD NO.	SWD NO.	DEPTH, FT.	GR	SA	FI	LL	PL	PI	LS	WC, %	PCF	MAJOR TESTS	DESCRIPTION OF MATERIAL
														PINE BLUFF ARSENAL - CLOSED HAZARDOUS WASTE SITE 23
30	DB-2	85/402	4.0-5.6				22	18	4		19.6	104	T-Q (1 PT)	CL-ML - SILTY CLAY, GRAY, MOIST, STIFF, IRON STAINED.
30	DB-9	85/409	19.5-21.5				35	15	20		20.9	103	T-Q (1 PT)	CL - LEAN CLAY, GRAY, MOIST, VERY STIFF, SOME FINE SAND NOTED IN SEAMS.
34	DB-3	85/416	4.5-6.5				23	19	4		17.1	110	T-Q (1 PT)	CL-ML - SILTY CLAY, GRAY, MOIST, VERY STIFF.
34	DB-10	85/423	20.0-22.0				NP	NP	NP	1	16.4	111	T-Q (1 PT)	ML - SANDY SILT, GRAY, MOIST.
34	DB-11	85/424	22.5-24.5				31	10	21		23.5	100	T-Q (1 PT)	CL - LEAN CLAY WITH SAND, GRAY, MOIST, VERY STIFF.





SPECIMEN NO.						
INITIAL	WATER CONTENT, %	w_o	19.6			
	DRY DENSITY LB/CU FT	γd_o	104			
	SATURATION, %	S_o	93			
	VOID RATIO	e_o	.540			
BEFORE SHEAR	WATER CONTENT, %	w_c				
	DRY DENSITY LB/CU FT	γd_c				
	SATURATION, %	S_c				
	VOID RATIO	e_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	.3			
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	0.52			
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f	4			
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.		D_o	5.5			
INITIAL HEIGHT, IN.		H_o	9.1			

CONTROLLED- **Stress** TEST

DESCRIPTION OF SPECIMENS SILTY CLAY (CL-ML)

LL 22	PL 18	PI 4	Gs 2.59	TYPE OF SPECIMEN **Undist.**	TYPE OF TEST Q

REMARKS:	PROJECT Pine Bluff Arsenal (DB-2)	
	BORING NO. 30	SAMPLE NO. 85/402
	DEPTH/ELEV 4.0-5.6	
	LABORATORY SWD	DATE Mar 85
	TRIAXIAL COMPRESSION TEST REPORT	

ENG FORM NO. 2089
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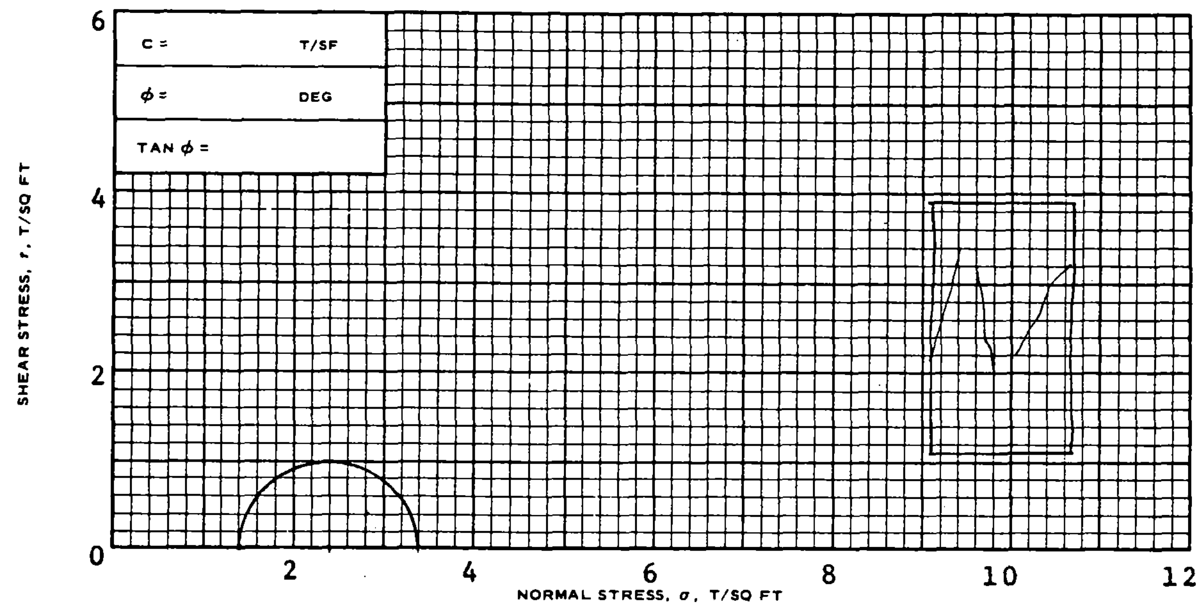

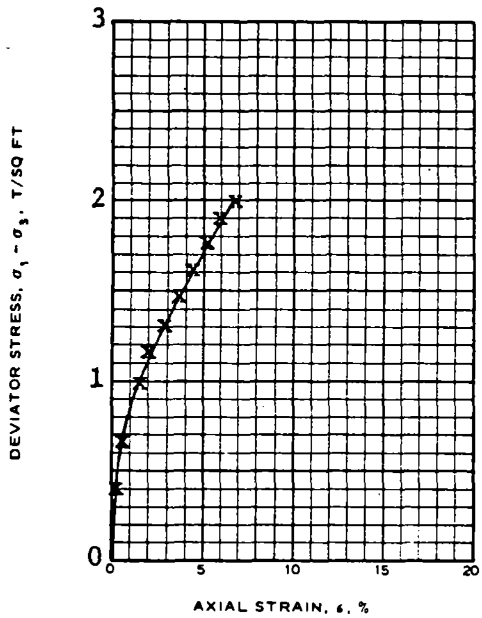

SPECIMEN NO.						
INITIAL	WATER CONTENT, %	w_o	20.9			
	DRY DENSITY LB/CU FT	γd_o	103			
	SATURATION, %	S_o	93			
	VOID RATIO	e_o	.588			
BEFORE SHEAR	WATER CONTENT, %	w_c				
	DRY DENSITY LB/CU FT	γd_c				
	SATURATION, %	S_c				
	VOID RATIO	e_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	1.4			
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	2.00			
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f	7			
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.		D_o	5.6			
INITIAL HEIGHT, IN.		H_o	10.3			

CONTROLLED- Stress TEST

DESCRIPTION OF SPECIMENS LEAN CLAY (CL)

LL 35	PL 15	PI 20	Gs 2.63	TYPE OF SPECIMEN Undist.	TYPE OF TEST Q

REMARKS:	PROJECT Pine Bluff Arsenal (DB-9)	
	BORING NO. 30	SAMPLE NO. 85/409
	DEPTH/ELEV 19.5-21.5	
	LABORATORY SWD	DATE Mar 85
	TRIAXIAL COMPRESSION TEST REPORT	

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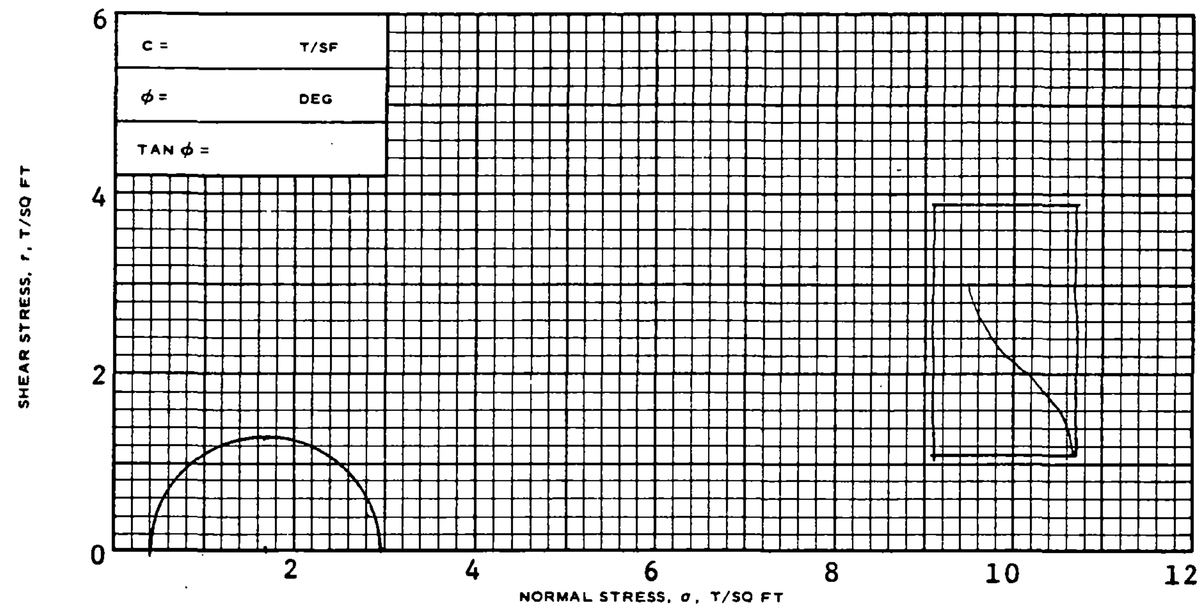

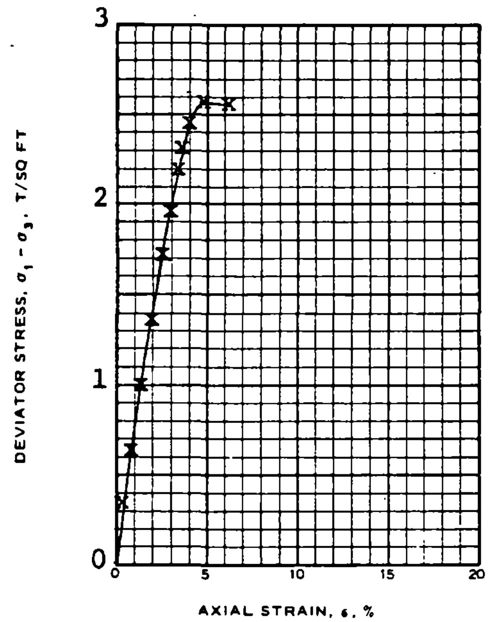

SPECIMEN NO.						
INITIAL	WATER CONTENT, %	w_o	17.1			
INITIAL	DRY DENSITY LB/CU FT	γd_o	110			
INITIAL	SATURATION, %	S_o	91			
INITIAL	VOID RATIO	e_o	.492			
BEFORE SHEAR	WATER CONTENT, %	w_c				
BEFORE SHEAR	DRY DENSITY LB/CU FT	γd_c				
BEFORE SHEAR	SATURATION, %	S_c				
BEFORE SHEAR	VOID RATIO	e_c				
BEFORE SHEAR	FINAL BACK PRESSURE, T/SQ FT	u_o				
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	.4			
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	2.55			
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f	9			
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.		D_o	5.5			
INITIAL HEIGHT, IN.		H_o	10.1			

CONTROLLED- Stress TEST

DESCRIPTION OF SPECIMENS SILTY CLAY (CL-ML)

LL 23	PL 19	PI 4	Gs 2.63	TYPE OF SPECIMEN Undist.	TYPE OF TEST Q

REMARKS:

PROJECT	Pine Bluff Arsenal (DB-3)
BORING NO. 34	SAMPLE NO. 85/416
DEPTH/ELEV	4.5-6.5
LABORATORY SWD	DATE Mar 85

TRIAXIAL COMPRESSION TEST REPORT

ENG FORM NO. 2089
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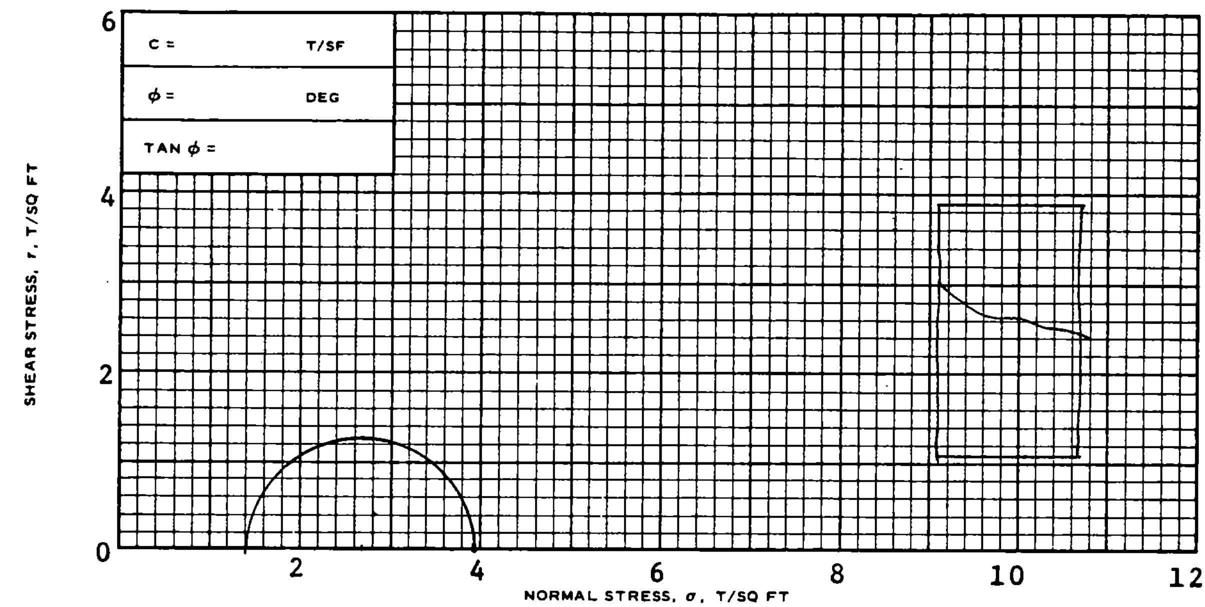

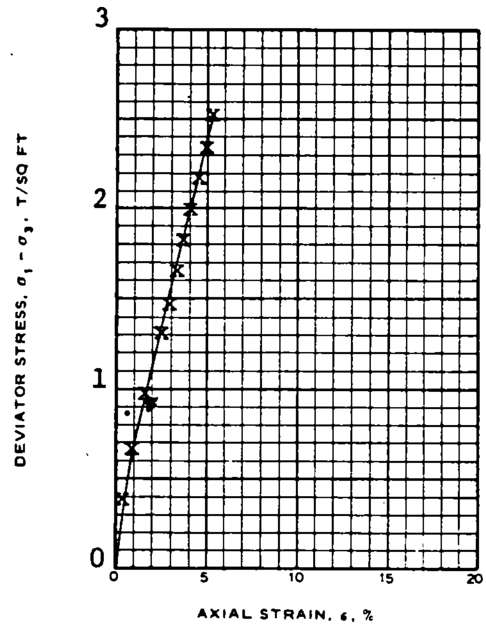

SPECIMEN NO.						
INITIAL	WATER CONTENT, %	w_o	16.4			
	DRY DENSITY LB/CU FT	γd_o	111			
	SATURATION, %	S_o	91			
	VOID RATIO	e_o	.480			
BEFORE SHEAR	WATER CONTENT, %	w_c				
	DRY DENSITY LB/CU FT	γd_c				
	SATURATION, %	S_c				
	VOID RATIO	e_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	1.4			
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	2.52			
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f	8			
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.		D_o	5.4			
INITIAL HEIGHT, IN.		H_o	10.2			

CONTROLLED- Stress TEST

DESCRIPTION OF SPECIMENS SANDY SILT (ML)

LL NP	PL NP	PI NP	Gs 2.65	TYPE OF SPECIMEN Undist.	TYPE OF TEST Q

REMARKS:	PROJECT Pine Bluff Arsenal (DB-10)	
	BORING NO. 34	SAMPLE NO. 85/423
	DEPTH/ELEV 20.0-22.0	
	LABORATORY SWD	DATE Mar 85
	TRIAXIAL COMPRESSION TEST REPORT	

ENG FORM NO. 2089
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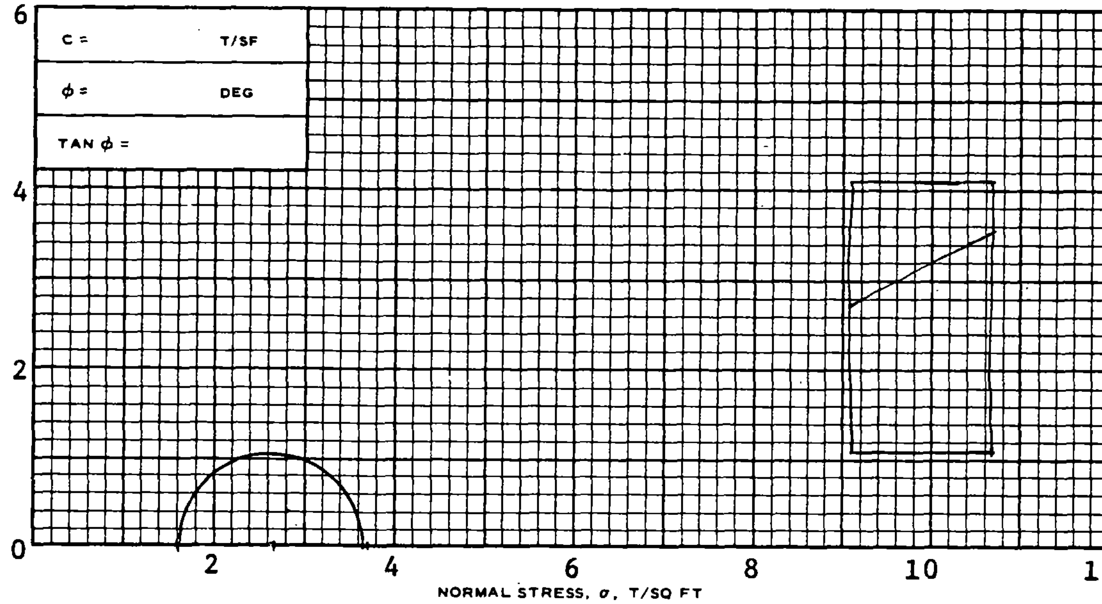
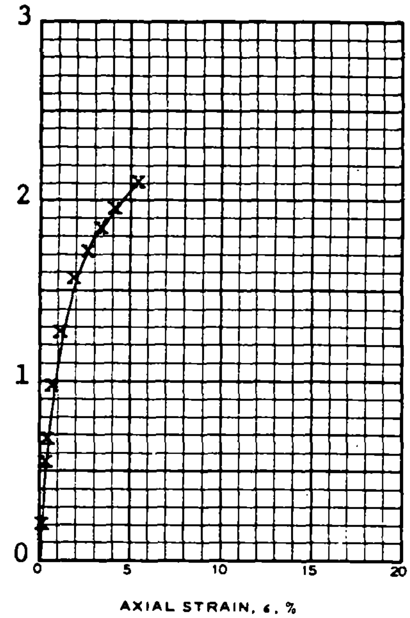




SPECIMEN NO.						
INITIAL	WATER CONTENT, %	w_o	23.5			
	DRY DENSITY LB/CU FT	γd_o	100			
	SATURATION, %	S_o	99			
	VOID RATIO	e_o	.626			
BEFORE SHEAR	WATER CONTENT, %	w_c				
	DRY DENSITY LB/CU FT	γd_c				
	SATURATION, %	S_c				
	VOID RATIO	e_c				
	FINAL BACK PRESSURE, T/SQ FT	u_o				
MINOR PRINCIPAL STRESS, T/SQ FT		σ_3	1.6			
MAXIMUM DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{MAX}$	2.10			
TIME TO $(\sigma_1 - \sigma_3)_{MAX}$, MIN		t_f	7			
ULTIMATE DEVIATOR STRESS, T/SQ FT		$(\sigma_1 - \sigma_3)_{ULT}$				
INITIAL DIAMETER, IN.		D_o	5.6			
INITIAL HEIGHT, IN.		H_o	10.9			

CONTROLLED- Stress TEST

DESCRIPTION OF SPECIMENS LEAN CLAY WITH SAND (CL)

LL 31	PL 10	PI 21	Gs 2.63	TYPE OF SPECIMEN Undist.	TYPE OF TEST Q

REMARKS:

PROJECT Pine Bluff Arsenal (DB-11)

BORING NO. 34 | SAMPLE NO. 85/424

DEPTH/ELEV 22.5-24.5

LABORATORY SWD | DATE Mar 85

TRIAXIAL COMPRESSION TEST REPORT

ENG FORM NO. 2089 REV JUNE 1970 PREVIOUS EDITION IS OBSOLETE

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13736-13 **(** 2 **pages)**

PROJECT: Pine Bluff Arsenal
Feature: Close Hazardous Waste Site 23A

Contract No.:

TEST REQUEST NO.: Telephone
Dated: 20 Mar 85
Received:

From: Chief
Geotechnical Branch
Tulsa District

MATERIAL: Disturbed Soil Samples
No. and type of samples: 17 jar samples
Source or other identification: Borings: 23A-30, 23A-34

Date received: 29 Jan 85

REMARKS:

Results of Tests — Table 1

Advance data sent 9 Apr 85

Report sent to:

Tulsa District

Copy furnished:

Date:	**Name and title:**	**Signature**
23 Apr 85	ARTHUR H. FEESE Director SWD Laboratory	

SWD FORM 896
8 SEP 77

BORING NO.		FLD NO.	SWD NO.	DEPTH, FT.	GR	SA	FI	LL	PL	PI	LS	WC, %	PCF	MAJOR TESTS	DESCRIPTION OF MATERIAL
															PINE BLUFF ARSENAL - CLOSED HAZARDOUS WASTE SITE 23A
23A	30	J-1	6/8438	2.0-2.5	0	18	82	NP	NP	NP	2	14.2			ML - SILT WITH SAND, GRAY, MOIST.
	30	J-2	6/8439	4.5-5.0	0	18	82	NP	NP	NP	3	14.0			ML - SILT WITH SAND, GRAY, MOIST.
	30	J-3	6/8440	5.6-6.1	1	40	59	NP	NP	NP	1	15.3			ML - SANDY SILT, LIGHT GRAY, MOIST.
	30	J-4	6/8441	6.8-7.3	6	17	77	NP	NP	NP	1	12.7			ML - SILT WITH SAND, GRAY, MOIST.
	30	J-5	6/8442	7.3-9.3	0	74	26	NP	NP	NP	0	20.5			SM - SILTY SAND, LIGHT BROWN AND YELLOW BROWN, WET.
	30	J-6	6/8443	11.7-12.2	0	64	36	NP	NP	NP	1	13.4			SM - SILTY SAND, GRAY AND YELLOW, MOIST.
	30	J-7	6/8444	14.0-14.5	0	91	9	NP	NP	NP	1	12.7			SP-SM - POORLY GRADED SAND WITH SILT, GRAY, VERY MOIST.
	30	J-8	6/8445	16.5-17.0	0	93	7	NP	NP	NP	0	16.7			SP-SM - POORLY GRADED SAND WITH SILT, GRAY, VERY MOIST.
23A	34	J-1	6/8484	1.5-2.0	0	24	76	NP	NP	NP	2	21.5			ML - SILT WITH SAND, GRAY, MOIST.
	34	J-2	6/8485	4.0-4.5	0	11	89	38	18	20	12	25.8			CL - LEAN CLAY, GRAY, MOIST. A FEW TINY ROOTS.
	34	J-3	6/8486	6.5-7.0	0	17	83	25	18	7	4	17.3			CL-ML - SILTY CLAY WITH SAND, GRAY, MOIST.
	34	J-4	6/8487	8.8-9.3	0	18	82	NP	NP	NP	1	16.2			ML - SILT WITH SAND, GRAY, MOIST.
	34	J-5	6/8488	11.0-11.5	0	71	29	NP	NP	NP	2	16.6			SM - SILTY SAND, GRAY, MOIST.
	34	J-6	6/8489	13.5-14.0	0	77	23	NP	NP	NP	1	22.7			SM - SILTY SAND, GRAY, MOIST.
	34	J-7	6/8490	16.0-16.5	0	79	21	NP	NP	NP	1	16.4			SM - SILTY SAND, GRAY, MOIST.
	34	J-8	6/8491	18.0-18.5	0	69	31	NP	NP	NP	1	18.0			SM - SILTY SAND, GRAY, MOIST.
	34	J-9	6/8492	19.5-20.0	0	85	15	NP	NP	NP	1	15.3			SM - SILTY SAND, GRAY, MOIST.

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13736-14 **(6 pages)**

PROJECT: Pine Bluff Arsenal
Feature: Close Hazardous Waste Site 23A

Contract No.:

TEST REQUEST NO.: Telephone
Dated: 12 Apr 85
Received:

From: Chief
Geotechnical Branch
Tulsa District

MATERIAL: Water
No. and type of samples: 2 jars
Source or other identification: pond
Site 23A

Date received: 12 Apr 85

REMARKS:

Results of TEsts for Priority Pollutants	Table 1
Results of Chemical Analysis of Water Samples	Table 2

Results of tests telephoned to TDO on 10 May 85

Report sent to:
Tulsa District Office

Copy furnished:

Date:	**Name and title:**	**Signature**
28 May 85	WILLIAM R. TANNER Assistant Director SWD Laboratory	William Tanner

Table 2

Results of Chemical Analysis of Water(1)

Hole	Field No.	SWD No.	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	
23A	J-1	9057		<0.01	<0.001	<0.50	0.005	<0.01	0.0003	0.06	0.0005		
Minimum Reported Concentration				0.01	0.001	0.50	0.002	0.01	0.0001	0.01	0.0004	0.01	

(1) Results reported in mg/l.

KEY LABORATORIES
Division of Production Profits
2636 WALNUT HILL LANE SUITE 275
DALLAS, TEX. 75229 214/350-5841

April 25, 1985

REPORT OF ANALYSIS

NUMBER:	A-1257
CLIENT:	Mr. Jeff Tye Southwestern Division Laboratory U.S. Army Corps of Engineers 4815 Cass Street Dallas, Texas 75235
DESCRIPTION:	The client submitted four samples for determination for priority pollutants.
PROCEDURE:	The samples were analyzed using GC/MS. The USEPA Methods 624 and 625 were followed for the anlysis.
RESULTS:	See attached data sheets.
QUALITY CONTROL STATEMENT:	Duplicate samples on volatiles showed 0.4% deviation for methylene chloride. Average surrogate recovery on Base/Neutrals and Acids was 98%.

Submitted by:

KEY LABORATORIES

Steve Jones

Steve T. Jones, Senior Chemist
STJ/kb

Table 1

SAMPLE Water DATE SUBMITTED 04/15/85

IDENTIFYING MARKS 9057 PBA Site 23A 4-10-85 ANALYTICAL REPORT NO. A-1257-7

SUBMITTED BY Southwestern Division
U.S. Army Corps of Engineers
Attention: Mr. Jeff Tye

ANALYSIS

Purgeable Organic Compounds
U.S.E.P.A. Method 624

COMPOUND	MDL ppb	Conc ppb
Chloromethane	10	NA
Bromomethane	10	NA
Vinyl Chloride	10	NA
Chloroethane	10	NA
Methylene Chloride	5	NA
Trichlorofluoromethane	3	NA
1,1 Dichloroethylene	4	NA
1,1 Dichloroethane	3	NA
trans-1,2-Dichloroethylene	3	NA
Chloroform	3	NA
1,2 Dichloroethane	3	NA
1,1,1 Trichloroethane	4	NA
Carbon Tetrachloride	4	NA
Bromodichloromethane	4	NA
1,2 Dichloropropane	4	NA
trans-1,3-Dichloropropylene	5	NA
Trichloroethylene	7	NA
Dibromochloromethane	3	NA
cis-1,3-Dichloropropylene	10	NA
1,1,2 Trichloroethane	5	NA
Benzene	3	NA
2-Chloroethylvinylether	10	NA
Bromoform	5	NA
Tetrachloroethylene	10	NA
1,1,2,2 Tetrachloroethane	7	NA
Toluene	2	NA
Chlorobenzene	3	NA
Ethyl Benzene	1	NA

NA = below minimum detectable level (MDL)

Table 1 (cont'd)

SAMPLE Water

DATE SUBMITTED 04/15/85

IDENTIFYING MARKS 9057 PBA Site 23A 4-10-85

ANALYTICAL REPORT NO. A-1257-7

SUBMITTED BY Southwestern Division
U.S. Army Corps of Engineers
Attention: Mr. Jeff Tye

ANALYSIS

U.S.E.P.A. Method 625
Base-Neutral Extractables

COMPOUND	MDL, ppb	Conc. ppb
1,3 Dichlorobenzene	2	NA
1,4 Dichlorobenzene	4	NA
Hexachloroethane	2	NA
1,2 Dichlorobenzene	2	NA
Bis(2-chloroisopropyl)ether	6	NA
Hexachlorobutadiene	2	NA
1,2,4 Trichlorobenzene	2	NA
Naphthalene	2	NA
Bis (2-chloroethyl) Ether	2	NA
Hexachlorocyclopentadiene	2	NA
Nitrobenzene	2	NA
Bis(2-chloroethoxy)Methane	5	NA
2-Chloronaphthalene	2	NA
Acenaphthylene	4	NA
Acenaphthene	2	NA
Isophorone	2	NA
Fluorene	2	NA
2,6 Dinitrotoluene	2	NA
1,2 Diphenylhydrazine	2	NA
2,4 Dinitrotoluene	6	NA
n-Nitrosodiphenylamine	2	NA
Hexachlorobenzene	2	NA
4-Bromophenyl phenyl ether	2	NA
Phenanthrene	2	NA

NA = below minimum detectable level (MDL)

Table 1 (cont'd)

SAMPLE Water

DATE SUBMITTED 04/15/85

IDENTIFYING MARKS 9057 PBA Site 23A 4-10-85

ANALYTICAL REPORT NO. A-1257-7

SUBMITTED BY Southwestern Division
U.S. Army Corps of Engineers
Attention: Mr. Jeff Tye

ANALYSIS

U.S.E.P.A. Method 625
Base-Neutral Extractables

COMPOUND	MDL, ppb	Conc. ppb
Anthracene	2	NA
Dimethyl phthalate	2	NA
Diethyl phthalate	22	NA
Fluoranthene	2	3
Pyrene	2	NA
Di-n-butyl phthalate	2	NA
Benzidene	30	NA
Butyl benzyl phthalate	3	NA
Chrysene	3	NA
Bis(2-ethylhexyl)phthalate	3	NA
Benzo (a) anthracene	8	NA
Benzo (b) fluoranthene	5	NA
Benzo (k) fluoranthene	3	NA
Benzo (a) pyrene	3	NA
Indeno (1,2,3-cd) pyrene	4	NA
Dibenzo (a,h) anthracene	3	NA
Benzo (g,h,i) perylene	4	NA
n-Nitrosodimethylamine	2	NA
n-Nitrosodi-n-propylamine	2	NA
4-Chlorophenyl phenyl ether	4	NA
3,3' Dichlorobenzidine	17	NA
2,3,7,8 TCDD	31	NA
Bis (chloromethyl) ether	6	NA
Di-n-octyl phthalate	3	NA

NA = below minimum detectable level (MDL)

Table 1 (cont'd)

SAMPLE Water

DATE SUBMITTED 04/15/85

IDENTIFYING MARKS 9057 PBA Site 23A 4-10-85

ANALYTICAL REPORT NO. A-1257-7

SUBMITTED BY Southwestern Division
U.S. Army Corps of Engineers
Attention: Mr. Jeff Tye

ANALYSIS

U.S.E.P.A. Method 625
Acid Extractables

COMPOUND	MDL, ppb	Conc. ppb
2-Chlorophenol	3	NA
Phenol	2	NA
2,4 Dichlorophenol	3	NA
2-Nitrophenol	4	NA
p-Chloro-m-Cresol	3	NA
2,4,6 Trichlorophenol	3	NA
2,4 Dimethylphenol	3	NA
2,4 Dinitrophenol	46	NA
2-Methyl-4,6 Dinitrophenol	26	NA
4-Nitrophenol	2	NA
Pentachlorophenol	4	NA
b-Endosulfan	110	NA
a-BHC	110	NA
y-BHC	110	NA
b-BHC	4	NA
Aldrin	2	NA
Heptachlor	2	NA
Heptachlor epoxide	2	NA
a-Endosulfan	110	NA
Dieldrin	3	NA
4,4'-DDE	7	NA
4,4'-DDD	3	NA
4,4'-DDT	4	NA
Endrin	110	NA
Endrin Aldehyde	110	NA
Endosulfan sulfate	7	NA
d-BHC	3	NA
Chlordane	1102	NA
Toxaphene	5508	NA
PCB (total)	110	NA

NA = below minimum detectable level (MDL)

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13736-15 (2 pages)

PROJECT: Pine Bluff Arsenal
Feature: Close Hazardous Waste Site 23A

Contract No.:

TEST REQUEST NO.: Telephone
Dated: 12 April 85
Received:

From: Chief
Geotechnical Branch
Tulsa District

MATERIAL: Water
No. and type of samples: 2 Jars
Source or other identification: Site 23A, Well 149

Date received: 8 and 18 April 1985

REMARKS:
Results of Chemical Analysis of Water Samples Table 1

Results of tests telephoned to TDO on 16 and 23 April 1985.

Report sent to:
Tulsa District Office

Copy furnished:

Date:
29 April 85

Name and title:
WILLIAM R. TANNER
Assistant Director
SWD Laboratory

Signature
W R Tanner

SWD FORM 896
8 SEP 77

SWDED-GL Report No. 13736-15

Pine Bluff Arsenal
Site 23A

Table 1
Results of Chemical Analysis of Water(1)

Hole	Field No.	SWD No.	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	Chlorides	Hexachlore Ethane	pH
23A	Well 149	9029		0.01	0.001	2.5	0.44	0.01	0.0001	0.21	0.0004	590	-----	-----	3.7
	Sample received 8 April 85 (Plastic bottles).														
23A	Well 149	9063		---	----	---	----	----	------	----	------	820	1,500	207 ppb	3.9
	Sample received 18 April 85 (Glass bottles).														
Minimum Reported Concentration				0.01	0.001	0.50	0.002	0.01	0.0001	0.01	0.0004	0.01		10	

(1) Results reported in mg/l, except Hexachloroethane reported in ppb.

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13736-16 (2 **pages)**

PROJECT: Pine Bluff Arsenal
Feature: Close Hazardous WAste Site 23A

Contract No.:

TEST REQUEST NO.: Telephone
Dated: 20 March 1985
Received:

From: Chief
Geotechnical Branch
Tulsa District

MATERIAL: Soil
No. and type of samples: 17 Jars
Source or other identification: Site 23A; hole 1,28 thru 35.

Date received: 19 March 1984 and 29 January 1985.

REMARKS:

Results of Tests of Soil for EP Toxicity Table 1

Results of tests telephoned to TDO on 22 April 1985.

Report sent to:

Tulsa District Office

Copy furnished:

Date: 06 Jun 85

Name and title: WILLIAM R. TANNER
Assistant Director
SWD Laboratory

Signature Wm R Tanner

SWD FORM 896
8 SEP 77

SWDED-GL Report 13736

Table 1

Pine Bluff Arsenal
Site 23A

Results of Chemical Analysis of Soil for EP Toxicity(1)

Hole	Field No	SWD No	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se
23A-1	J-7	5389	10 0-12 0	<0 01	0 001	<0 50	0 072	0 02	0 0001	0.63	<0 0004
28	J-1	8415	0 0-0 8	<0 01	<0 001	0 86	0 077	0 02	<0.0001	0 37	<0 0004
28	J-1	8419	9 0-12 0	<0 01	<0 001	<0 50	0 007	<0 01	<0 0001	0 03	<0 0004
29	J-1	8426	0 0-3 0	<0 01	<0 001	<0 50	0 022	<0 01	<0 0001	0 07	<0 0004
29	J-5	8430	8 0-11.0	<0 01	<0 001	<0 50	0 005	<0 01	<0 0001	0 02	<0 0004
30	J-1	8438	2 0-2 5	<0 01	<0 001	<0 50	0 005	<0 01	<0.0001	0 07	<0 0004
30	J-5	8442	7 3-9 3	<0 01	<0 001	<0 50	0 005	<0 01	<0 0001	<0 01	<0 0004
31	J-1	8451	0 0-3 0	<0 01	<0 001	0 93	0 005	<0 01	<0 0001	0 05	<0 0004
31	J-5	8455	12 0-15 0	<0 01	<0 001	<0 50	0 005	<0 01	<0 0001	0 01	<0 0004
32	J-1	8462	0 0-3 0	<0 01	<0 001	<0 50	0 005	<0 01	<0 0001	0 05	<0 0004
32	J-5	8466	11 0-12 0	Insufficient Sample							
33	J-1	8474	0 0-3 0	<0 01	<0 001	<0 50	0 003	<0 01	<0 0001	<0 01	<0 0004
33	J-5	8478	12 0-15.0	<0 01	<0 001	<0 50	0 008	<0.01	<0 0001	0 13	<0 0004
34	J-1	8484	1 5-2 0	<0 01	<0 001	<0 50	0 005	<0 01	<0 0001	0 08	<0 0004
34	J-5	8488	11 0-11 5	<0 01	<0 001	<0 50	0 003	<0 01	<0 0001	0 06	<0 0004
35	J-1	8497	0 0-3.0	<0 01	<0 001	<0 50	0 005	<0 01	<0 0001	0 04	<0 0004
35	J-5	8501	12 0-13.5	<0 01	<0 001	<0 50	0 008	<0 01	<0 0001	0 02	<0 0004
Minimum Reported Concentration				0 01	0 001	0 50	0 002	0 01	0 0001	0 01	0 0004
EP Toxicity Limits				5 0	5 0	100 0	1 0	5 0	0 2	5 0	1 0

(1) Results reported in mg/l

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13736-17 (2 pages)

PROJECT: Pine Bluff Arsenal
Feature: Close Hazardous Waste Site 23A

Contract No.:

TEST REQUEST NO.: Telephone
Dated: 25 April 1985
Received:

From: Chief
Geotechnical Branch
Tulsa District

MATERIAL: Soil
No. and type of samples: 1 Jar
Source or other identification: Site 23A; hole 1.

Date received: 19 March 1984

REMARKS:

Results of Tests of Soil for EP Toxicity Table 1

Results of tests telephoned to TDO on 17 May 1985.

Report sent to:

Tulsa District

Copy furnished:

Date:	Name and title:	Signature
06 Jun 85	WILLIAM R. TANNER Assistant Director SWD Laboratory	Wm R Tanner

SWD FORM 896
8 SEP 77

SWDED-GL Report 13736

Table 1

Pine Bluff Arsenal
Site 23A

Results of Chemical Analysis of Soil for EP Toxicity[1]

Hole	Field No.	SWD No.	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se
23A-1	J-8	5390	12.0.14.0	<0.01	<0.001	<0.50	0.028	<0.01	<0.0001	0.02	<0.0004
Minimum Reported Concentration				0.01	0.001	0.50	0.002	0.01	0.0001	0.01	0.0004
EP Toxicity Limits				5.0	5.0	100.0	1.0	5.0	0.2	5.0	1.0

(1) Results reported in mg/l.

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 13736-18 (2 pages)

PROJECT: Pine Bluff Arsenal
Feature: Close Hazardous Site 23

Contract No.:

TEST REQUEST NO.: Telephone
Dated: 13 May 1985
Received:

From: Chief
Geotechnical Branch
Tulsa District

MATERIAL: Soil
No. and type of samples: 17 Jars
Source or other identification: Site 23, holes 1 and 28 thru 35.

Date received: 29 January 1985

REMARKS:
Results of Chemical Analysis of Soil Samples Table 1

Results of tests telephoned to TDO on 17 May 1985.

Report sent to:

Tulsa District Office

Copy furnished:

Date:
11 June 85

Name and title:
WILLIAM R. TANNER
Assistant Director
SWD Laboratory

Signature
Wm R Tanner

SWD FORM 896
8 SEP 77

Results of Chemical Analysis of Soil(1)

Hole	Field No.	SWD No.	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Hexachloroethane
23-1	J-7	5389	10.0-12.0	INSUFFICIENT MATERIAL								
23-28	J-1	8415	0.0-0.8									<0.10
	J-5	8419	9.0-12.0									<0.10
23-29	J-1	8426	0.0-3.0	INSUFFICIENT MATERIAL								
	J-5	8430	8.0-11.0									<0.10
23-30	J-1	8438	2.0-2.5	INSUFFICIENT MATERIAL								
	J-5	8442	7.3-9.3									<0.10
23-31	J-1	8451	0.0-3.0	INSUFFICIENT MATERIAL								
	J-5	8455	12.0-15.0	INSUFFICIENT MATERIAL								
23-32	J-1	8462	0.0-3.0	INSUFFICIENT MATERIAL								
	J-5	8466	11.0-12.0	INSUFFICIENT MATERIAL								
23-33	J-1	8474	0.0-3.0									<0.10
	J-5	8478	12.0-15.0	INSUFFICIENT MATERIAL								
23-34	J-1	8484	1.5-2.0									<0.10
	J-5	8488	11.0-11.5									<0.10
23-35	J-1	8497	0.0-3.0	INSUFFICIENT MATERIAL								
	J-5	8501	12.0-13.5									<0.10
Minimum reported concentration				0.5	1.0	20.0	0.5	5.0	0.1	1.0	0.1	0.10

(1) Results reported in mg/kg

APPENDIX III
BORING - CONTAMINANT PLOTS

LEGEND

CONTAMINATED DEBRIS AND RUBBLE

SAND AND GRAVEL

SILT AND SANDY CLAY

CLAY

CLAY SHALE OR SILTSTONE
OF THE JACKSON GROUP

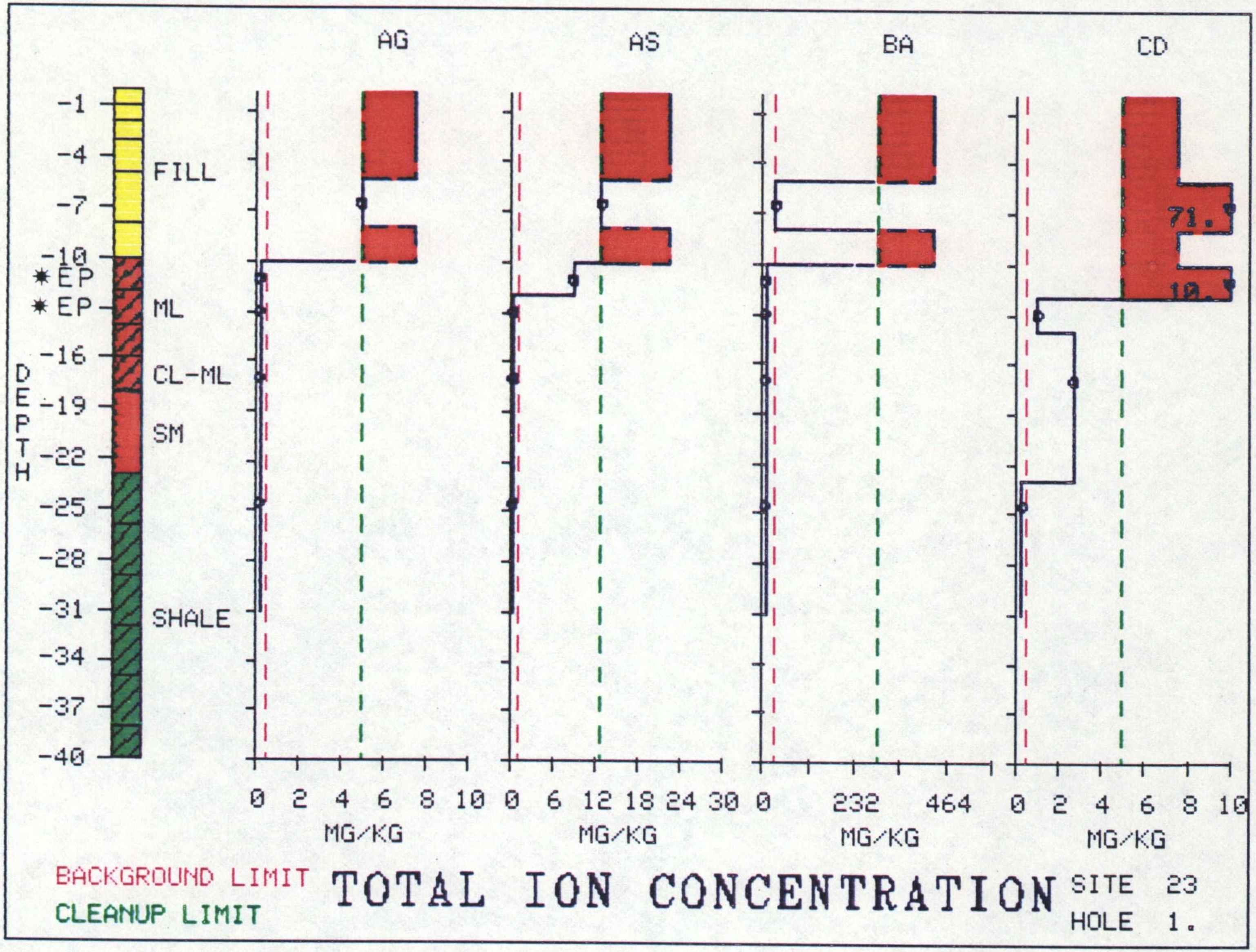
SAND OR POORLY CEMENTED SANDSTONE
OF THE JACKSON GROUP

MIDDEPTH OF SOIL SAMPLE TESTED

BACKGROUND LIMIT — Average concentration of contaminant in soil at Pine Bluff Arsenal. (or minimum detectable value)

CLEANUP LIMIT — Concentration to which site will be cleaned up (10 times background limit). The color "red" to the right of the cleanup limit indicates contamination.

*EP — LOCATION OF SAMPLE TESTED FOR EP TOXICITY



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AS
BA
CD
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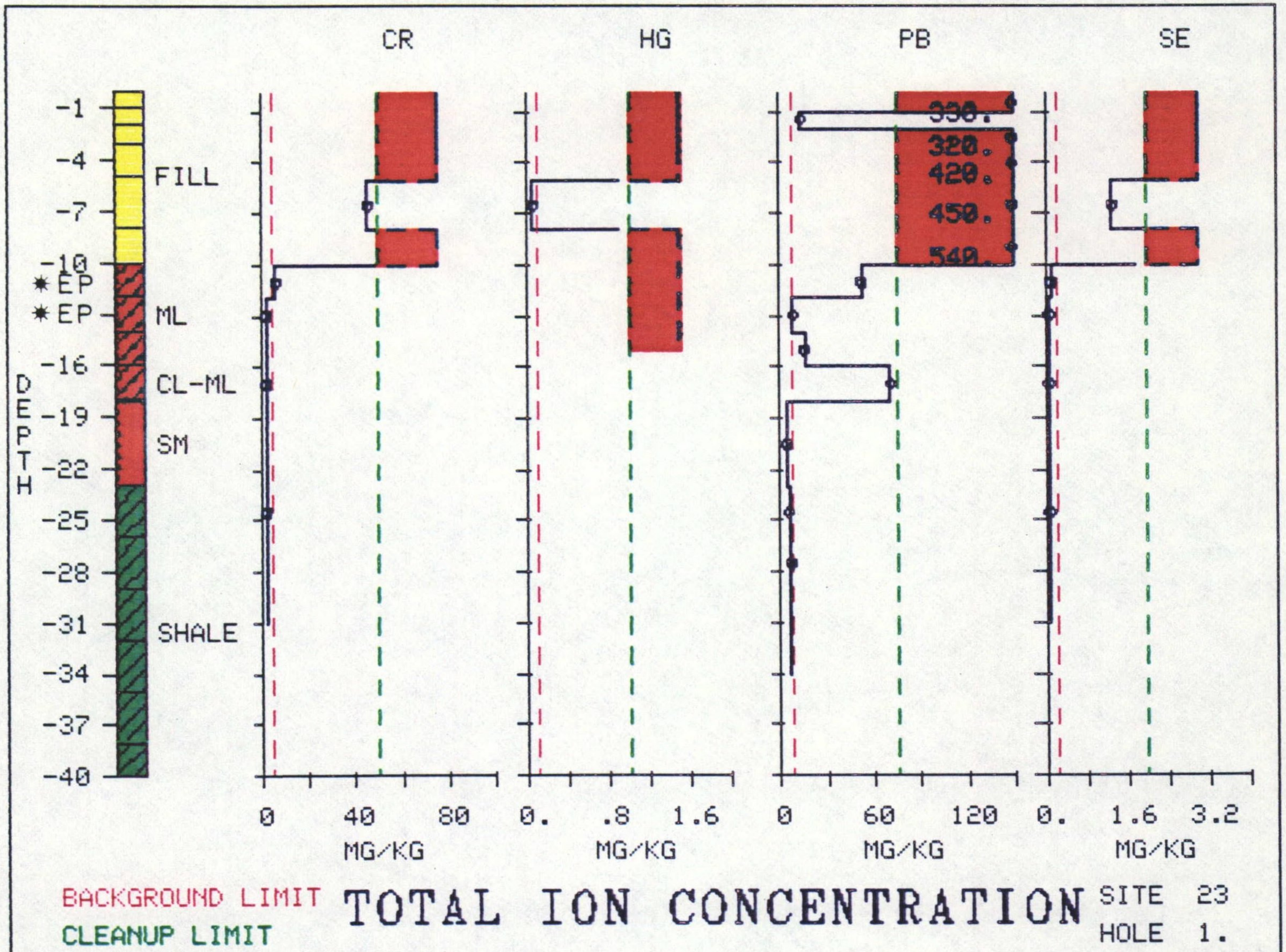
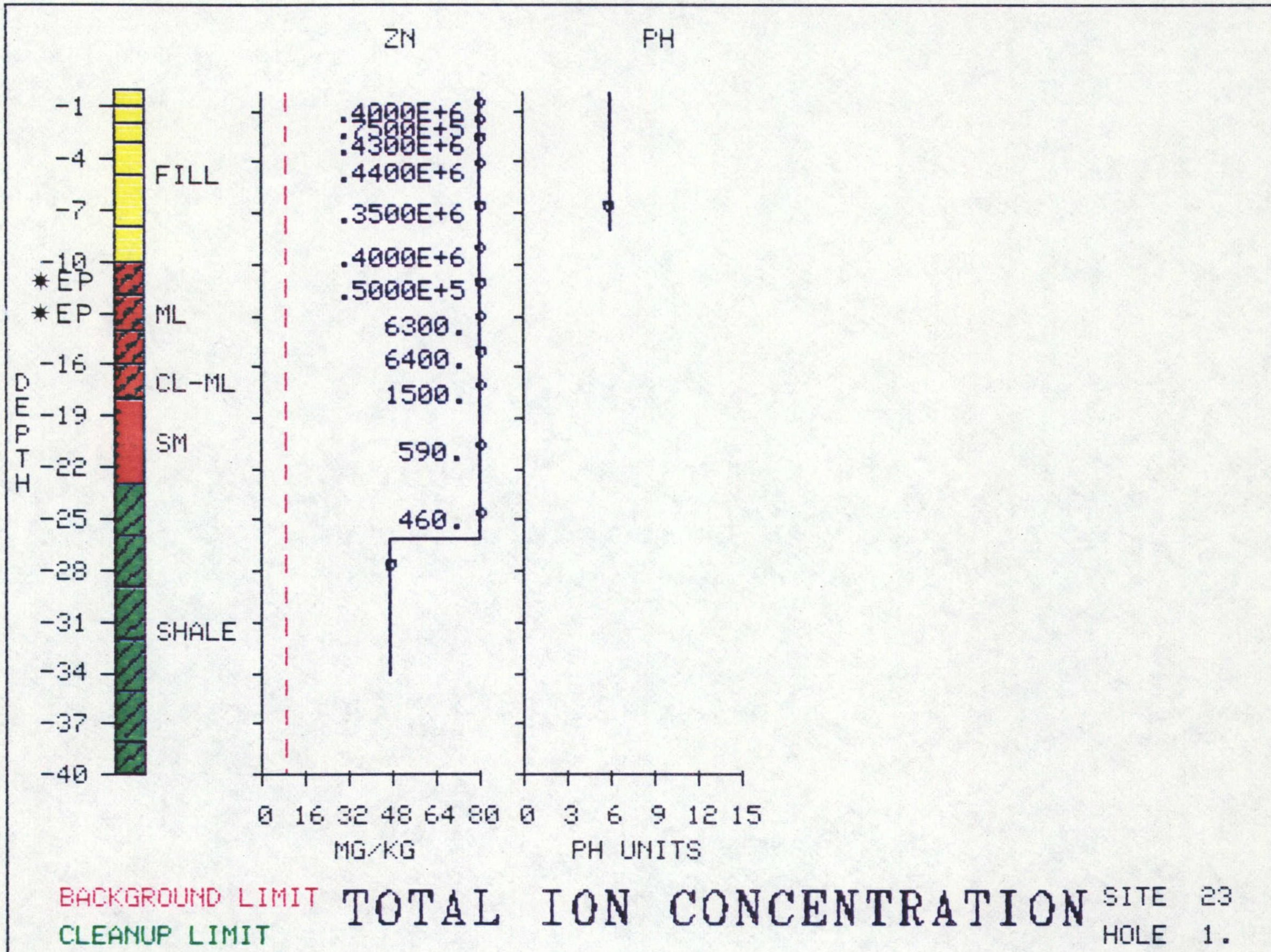
-4
-7
-10
-16
-19
-22
-25
-28
-31
-34
-37
-40
DEPTH
* EP
* EP
FILL
ML
CL-ML
SM
SHALE
71.
10.
0 2 4 6 8 10
0 6 12 18 24 30
0 232 464
0 2 4 6 8 10
MG/KG
MG/KG
MG/KG
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 1.



TOTAL ION CONCENTRATION



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PH
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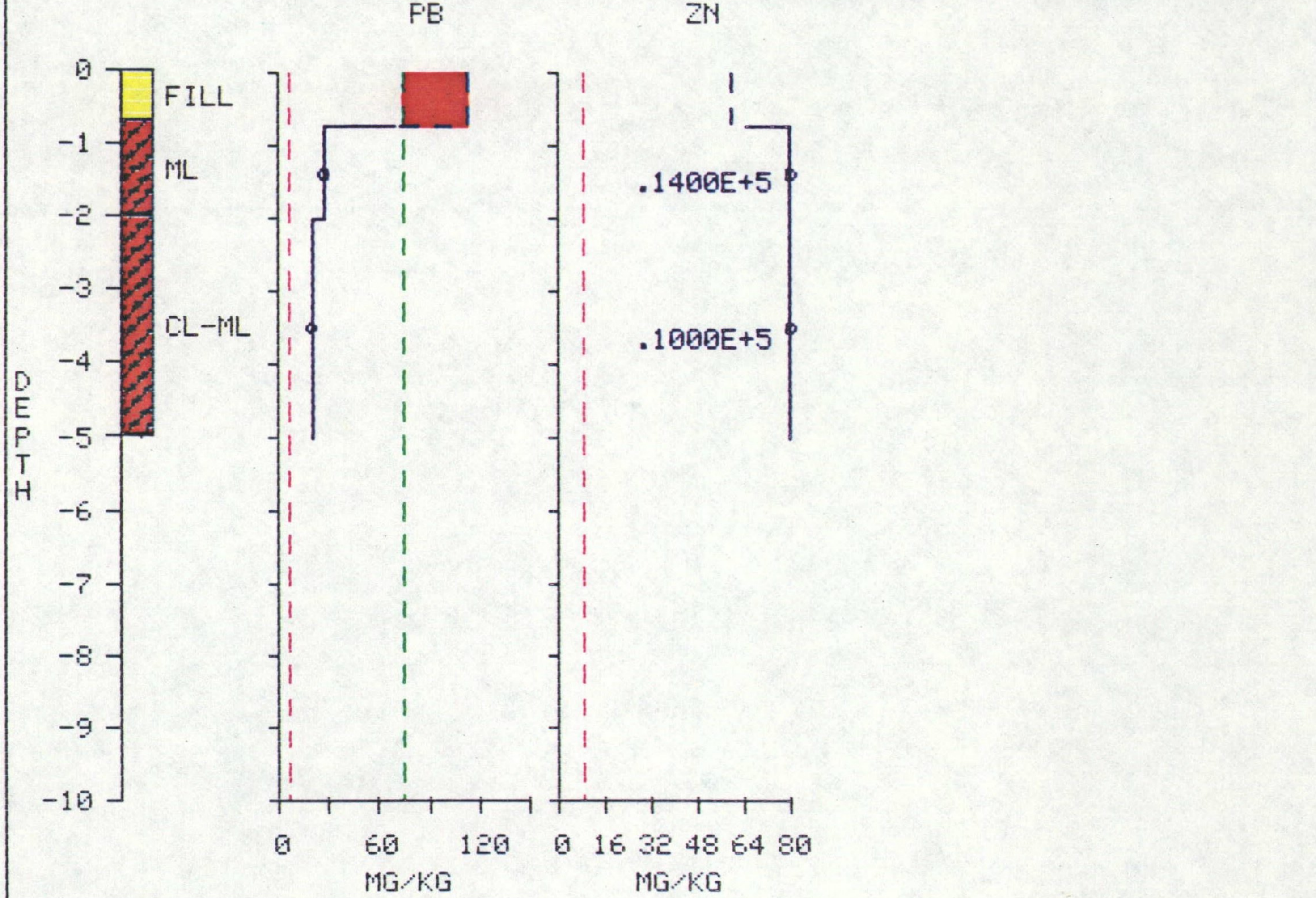
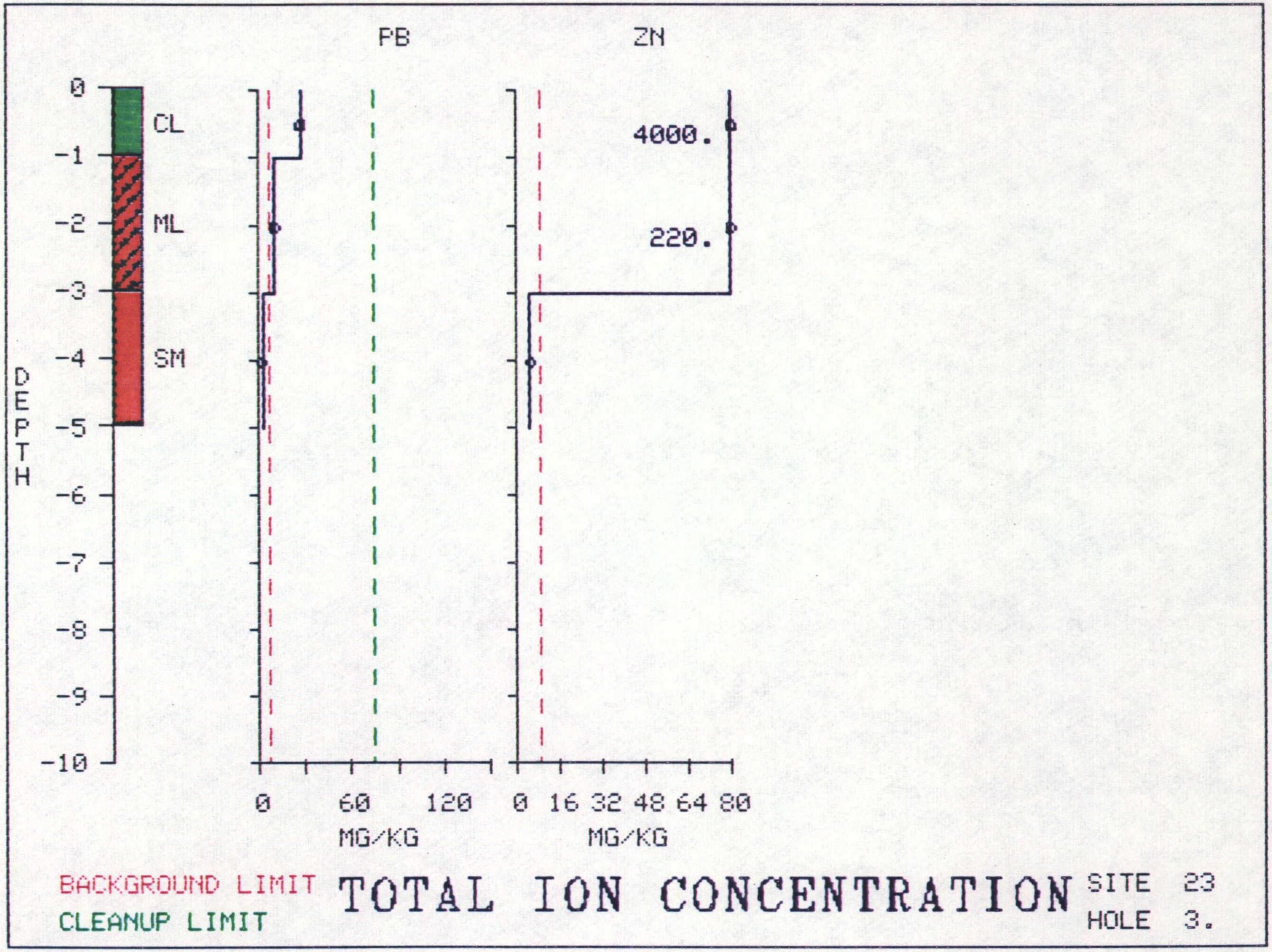
-4
-7
-10
-13
-16
-19
-22
-25
-28
-31
-34
-37
-40
DEPTH
*EP
*EP
FILL
ML
CL-ML
SM
SHALE
.4000E+6
.2500E+5
.4300E+6
.4400E+6
.3500E+6
.4000E+6
.5000E+5
6300.
6400.
1500.
590.
460.
0 16 32 48 64 80
MG/KG
0 3 6 9 12 15
PH UNITS
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 1.

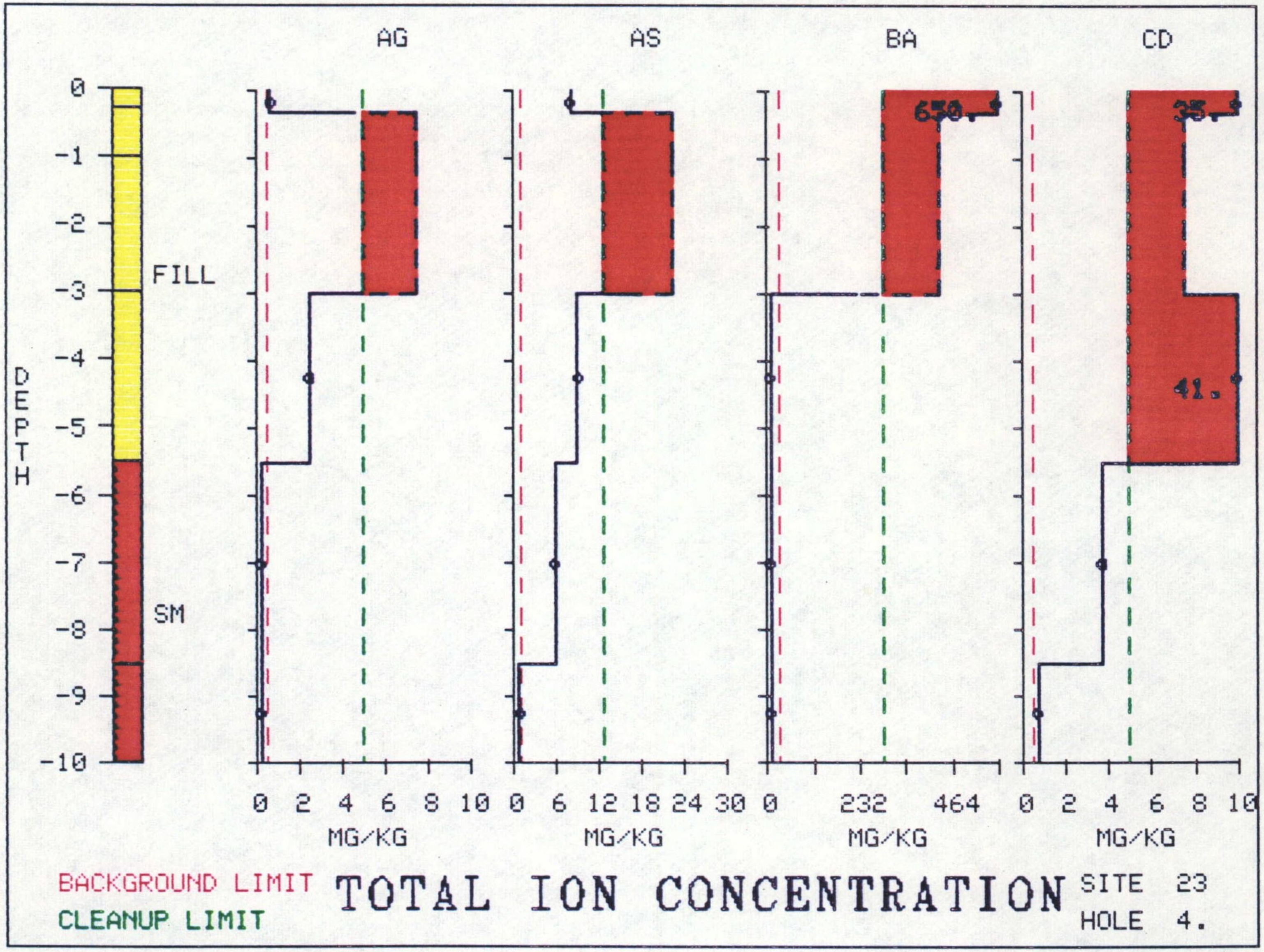


TOTAL ION CONCENTRATION

SITE 23
HOLE 2.



PB
ZN
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
DEPTH
CL
ML
SM
4000.
220.
0
60
120
MG/KG
0
16
32
48
64
80
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 3.



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AS
BA
CD
0
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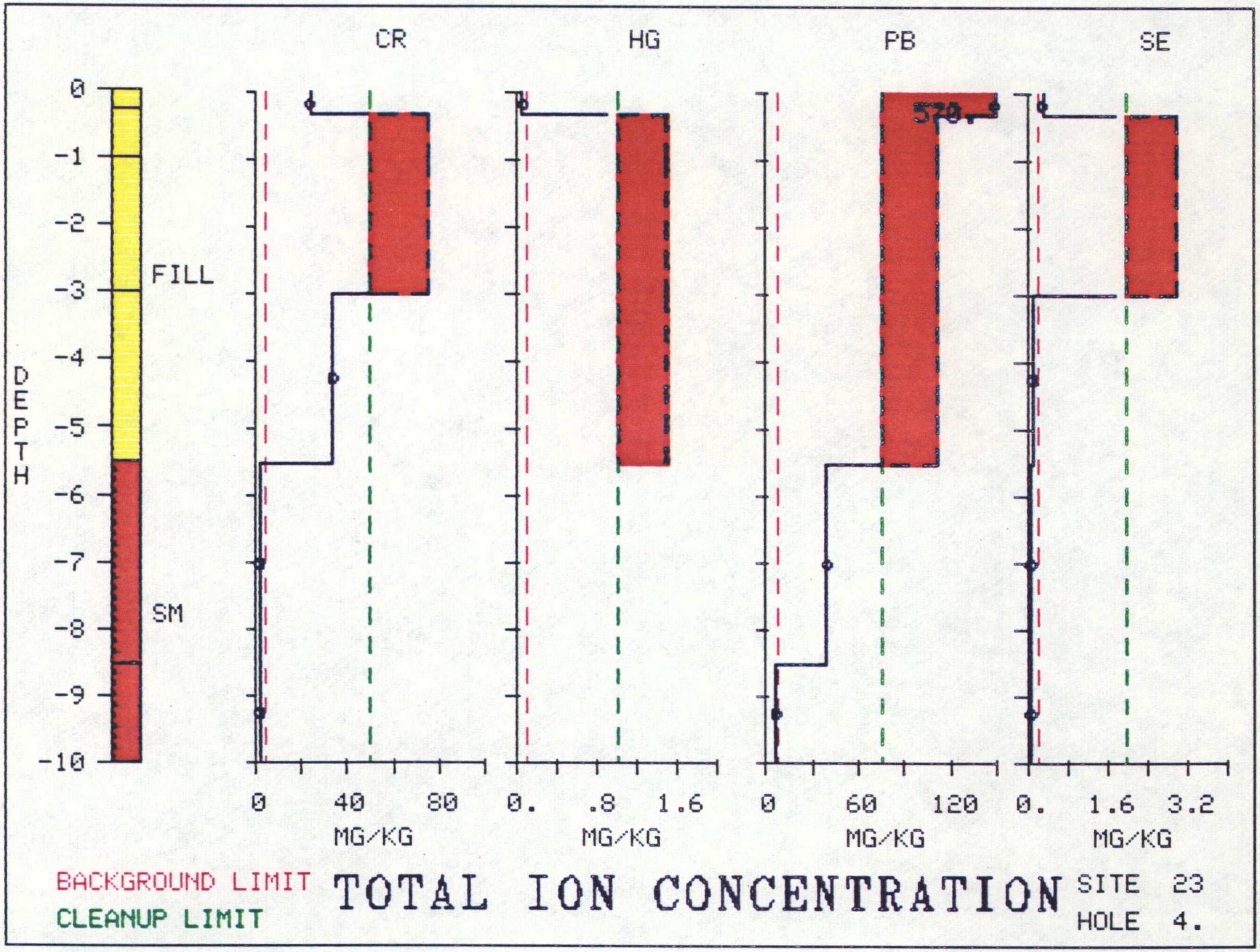
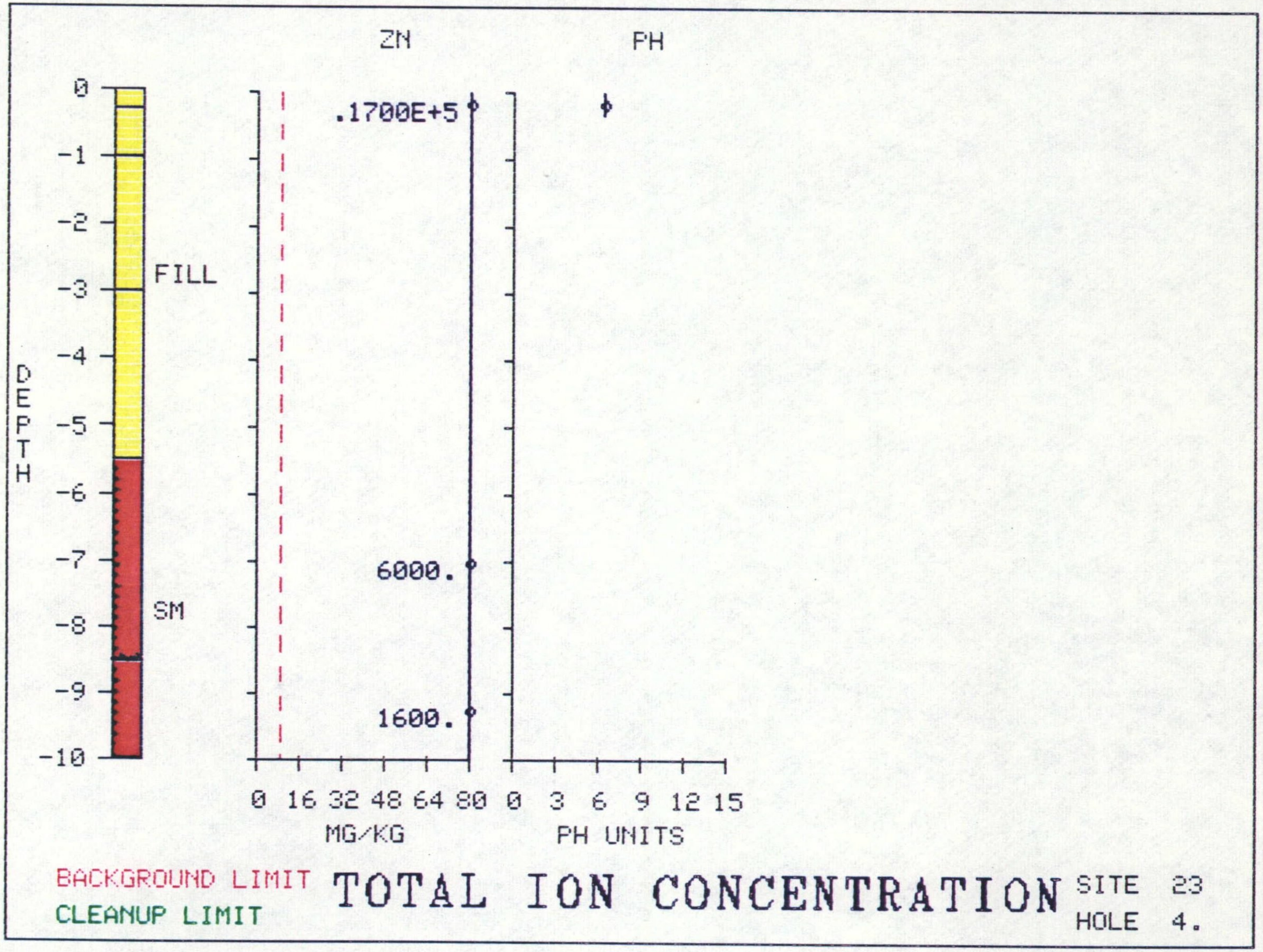
-2
-3
-4
-5
-6
-7
-8
-9
-10
DEPTH
FILL
SM
650.
35.
41.
0 2 4 6 8 10
0 6 12 18 24 30
0 232 464
0 2 4 6 8 10
MG/KG
MG/KG
MG/KG
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 4.



CR
HG
PB
SE
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
DEPTH
FILL
SM
570.
0 40 80
MG/KG
0. .8 1.6
MG/KG
0 60 120
MG/KG
0. 1.6 3.2
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 4.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PH
DEPTH
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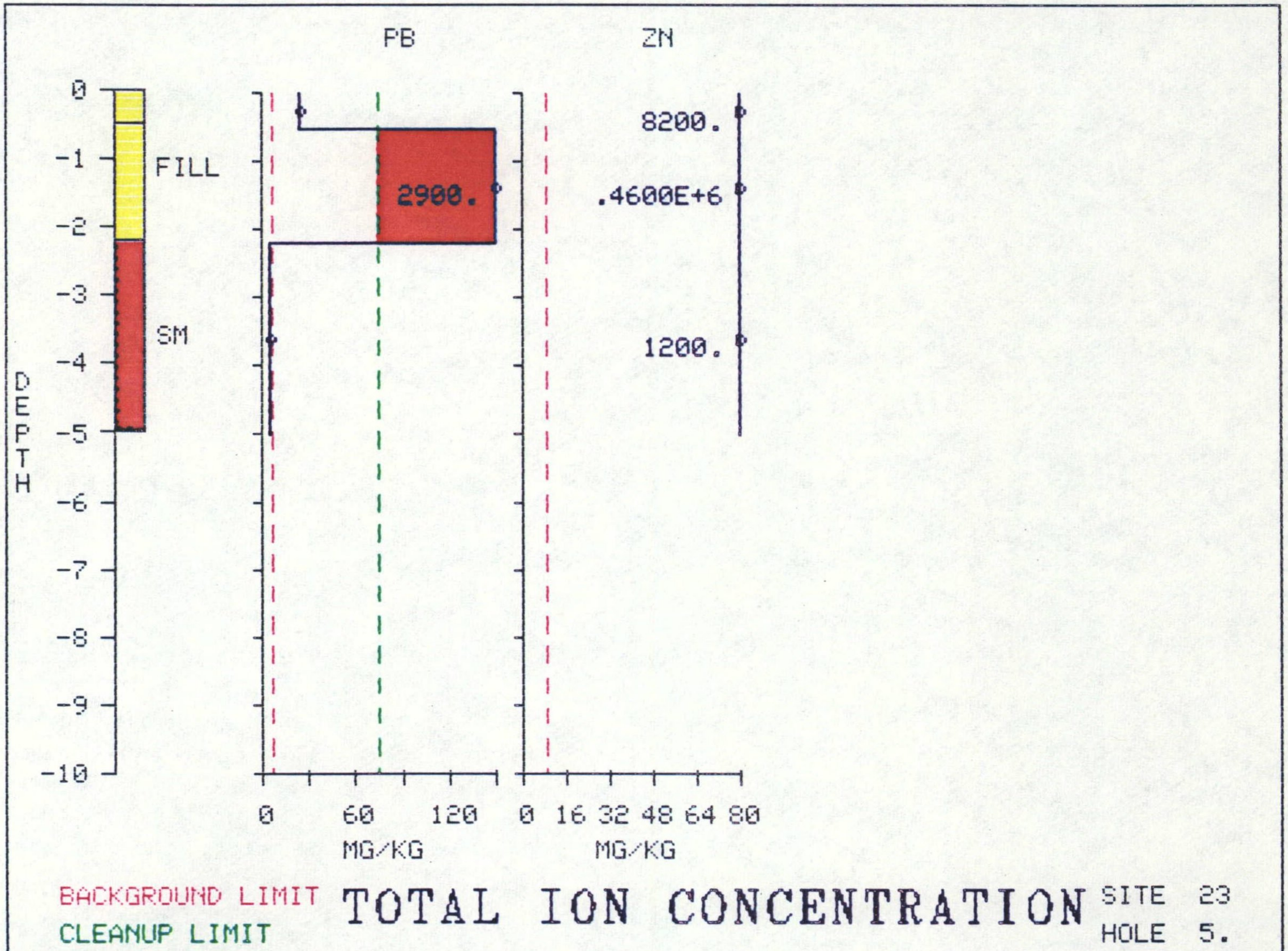
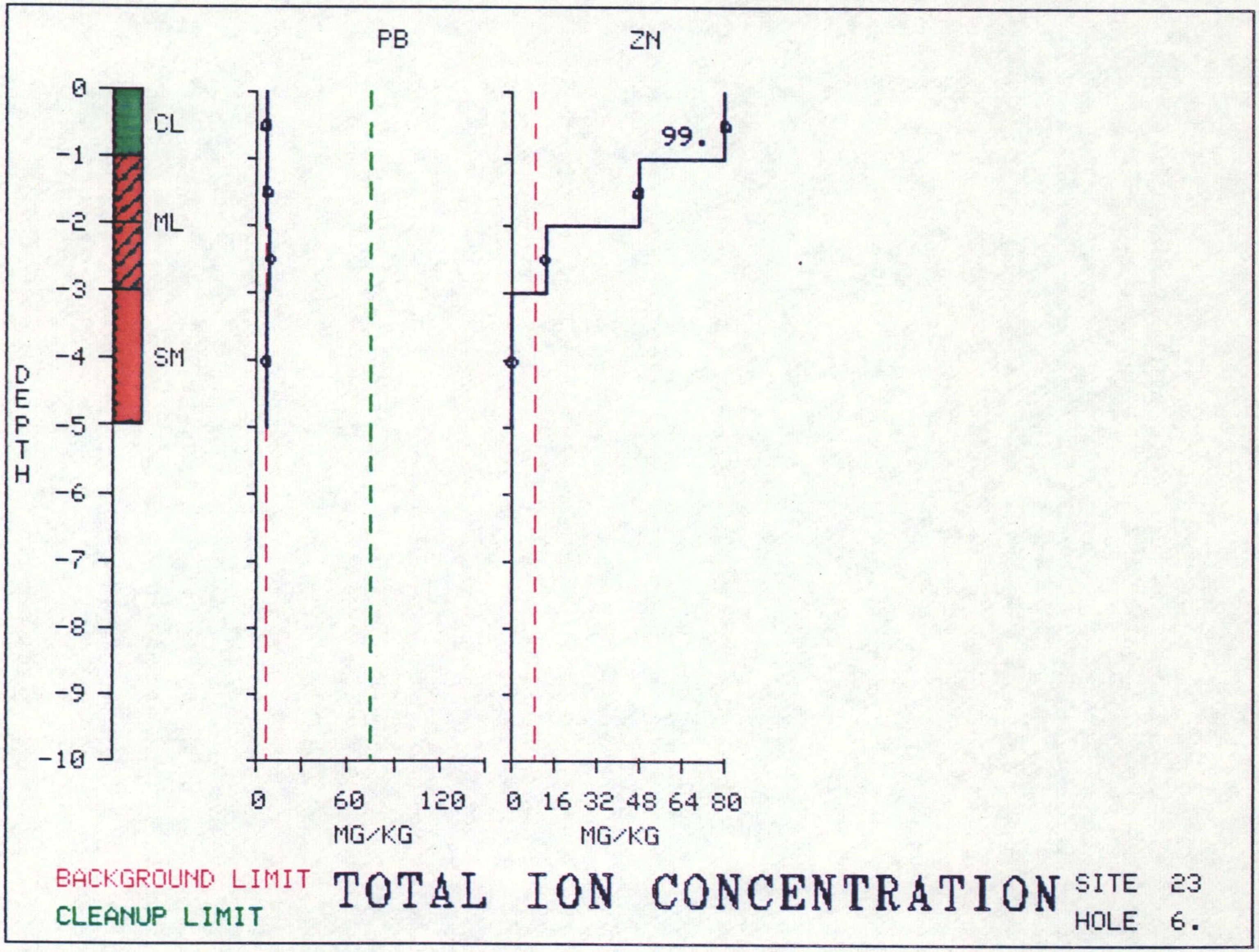
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
FILL
SM
.1700E+5
6000.
1600.
0 16 32 48 64 80
MG/KG
0 3 6 9 12 15
PH UNITS
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 4.



TOTAL ION CONCENTRATION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ZN
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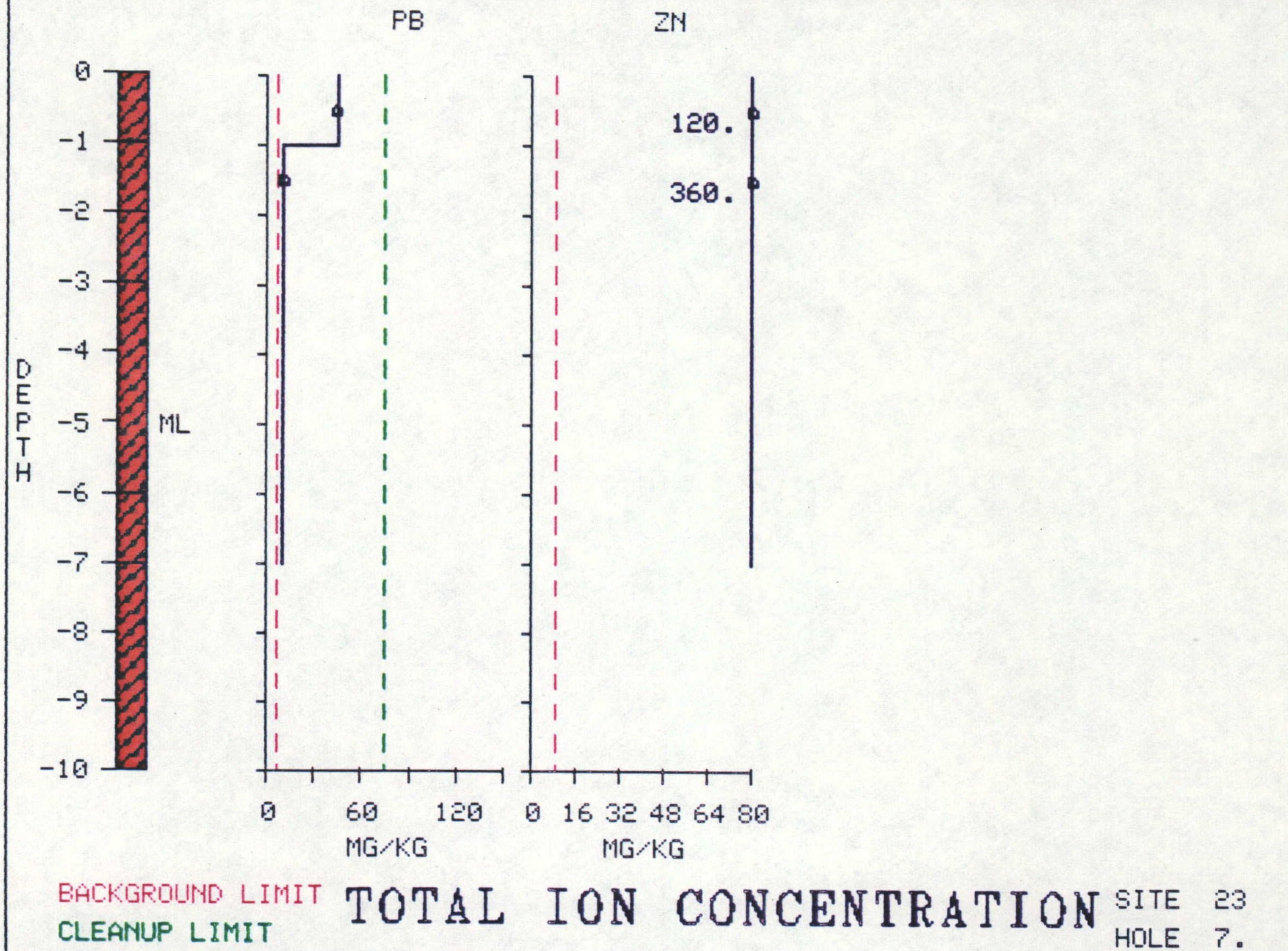
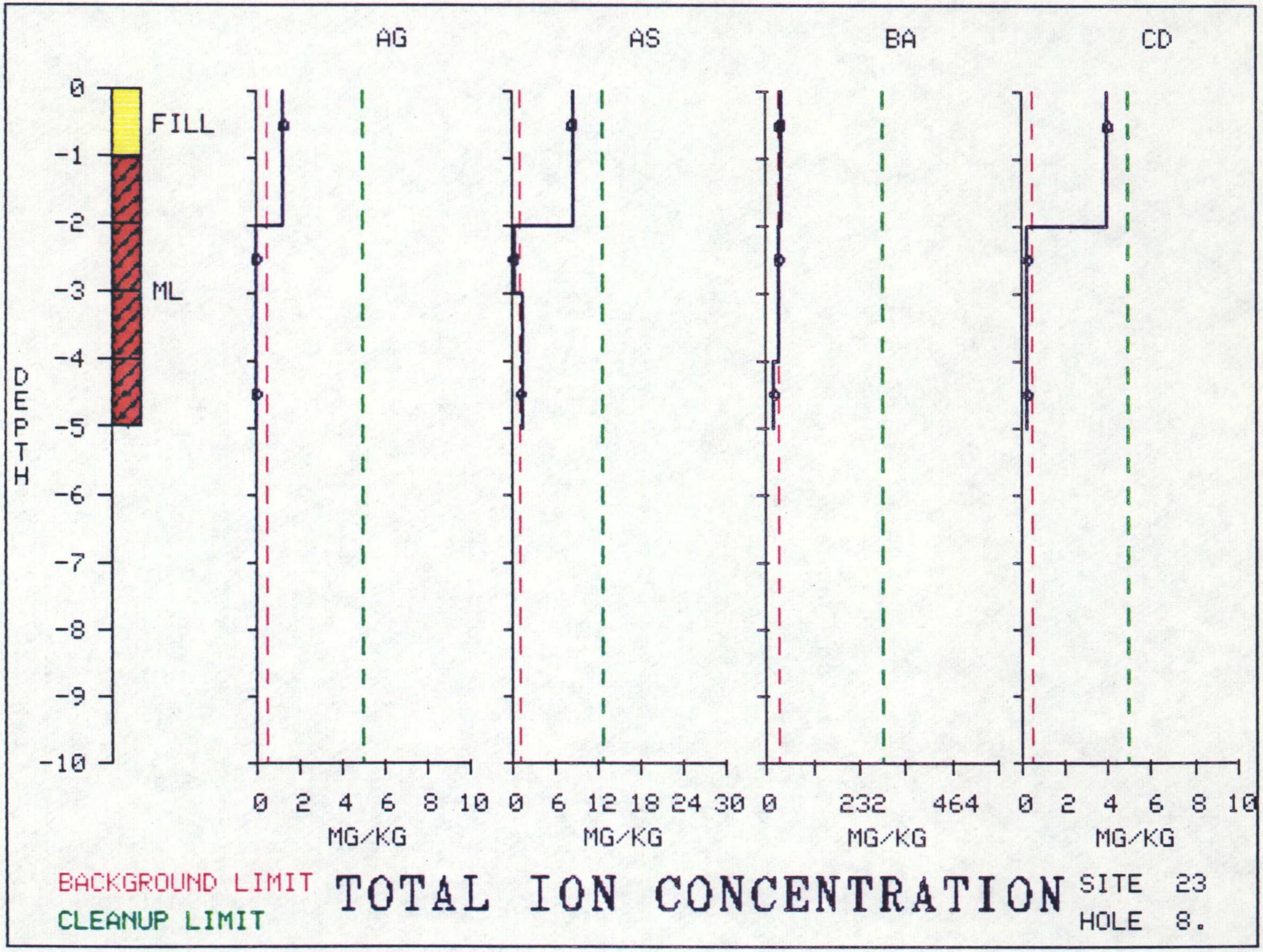
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
DEPTH
CL
ML
SM
99.
0
60
120
MG/KG
0
16
32
48
64
80
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 6.

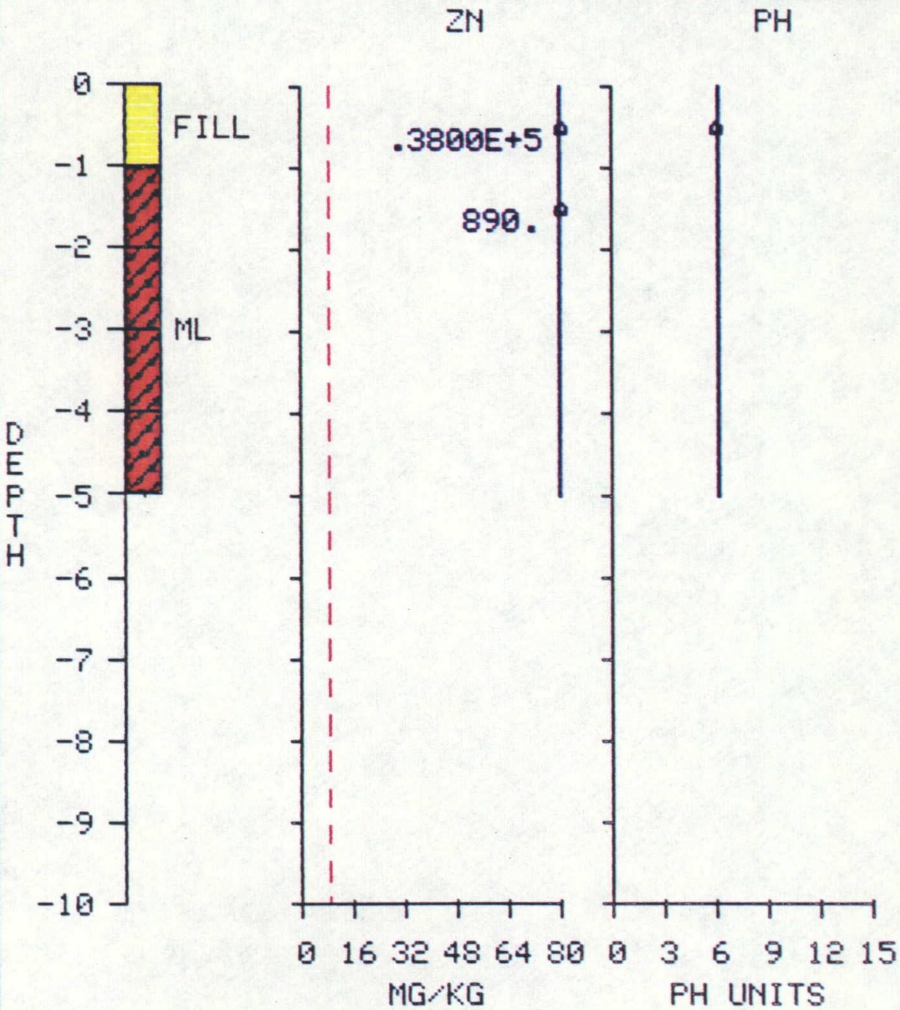


TOTAL ION CONCENTRATION

SITE 23
HOLE 7.

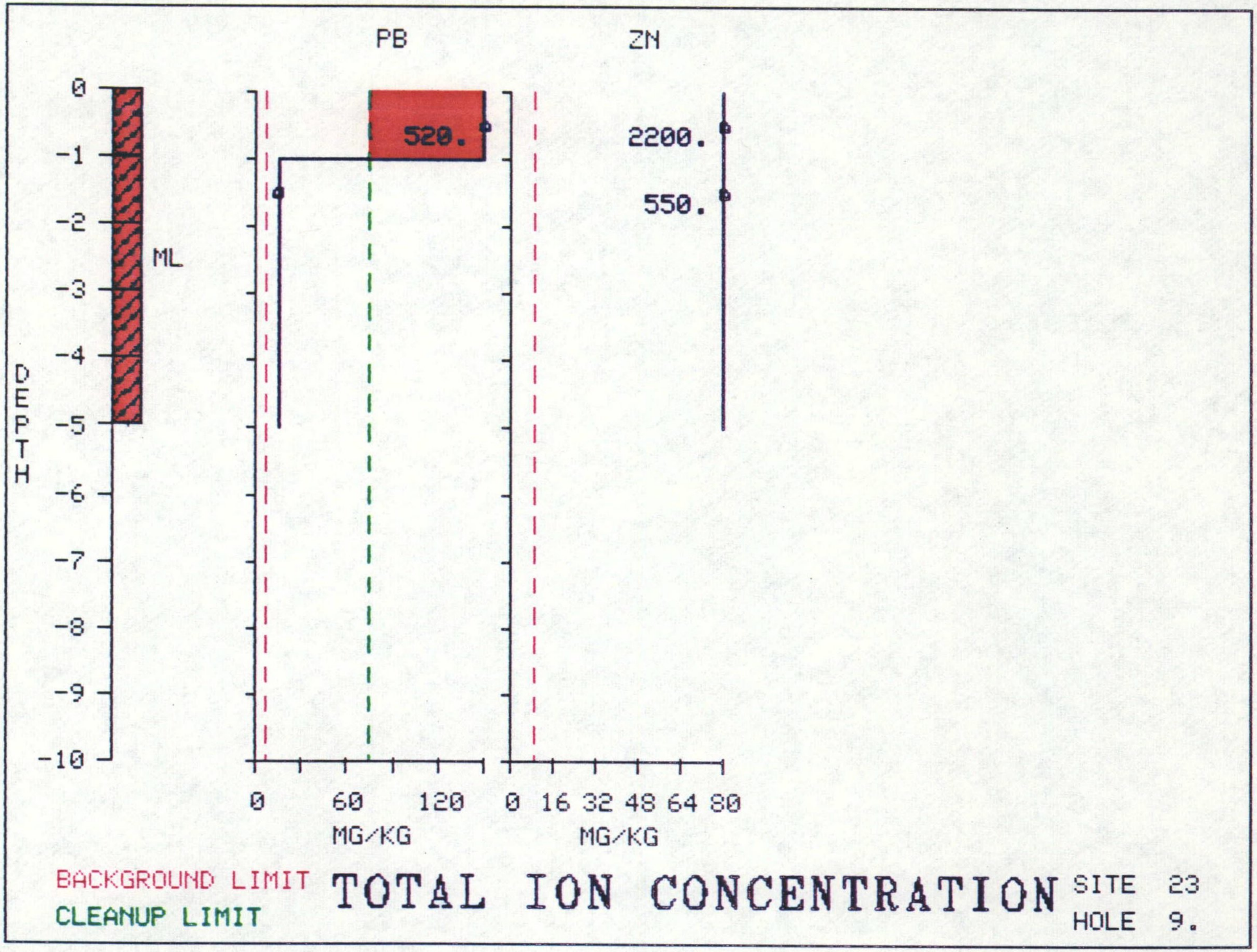


AG
AS
BA
CD
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
DEPTH
FILL
ML
0 2 4 6 8 10
0 6 12 18 24 30
0 232 464
0 2 4 6 8 10
MG/KG
MG/KG
MG/KG
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 8.

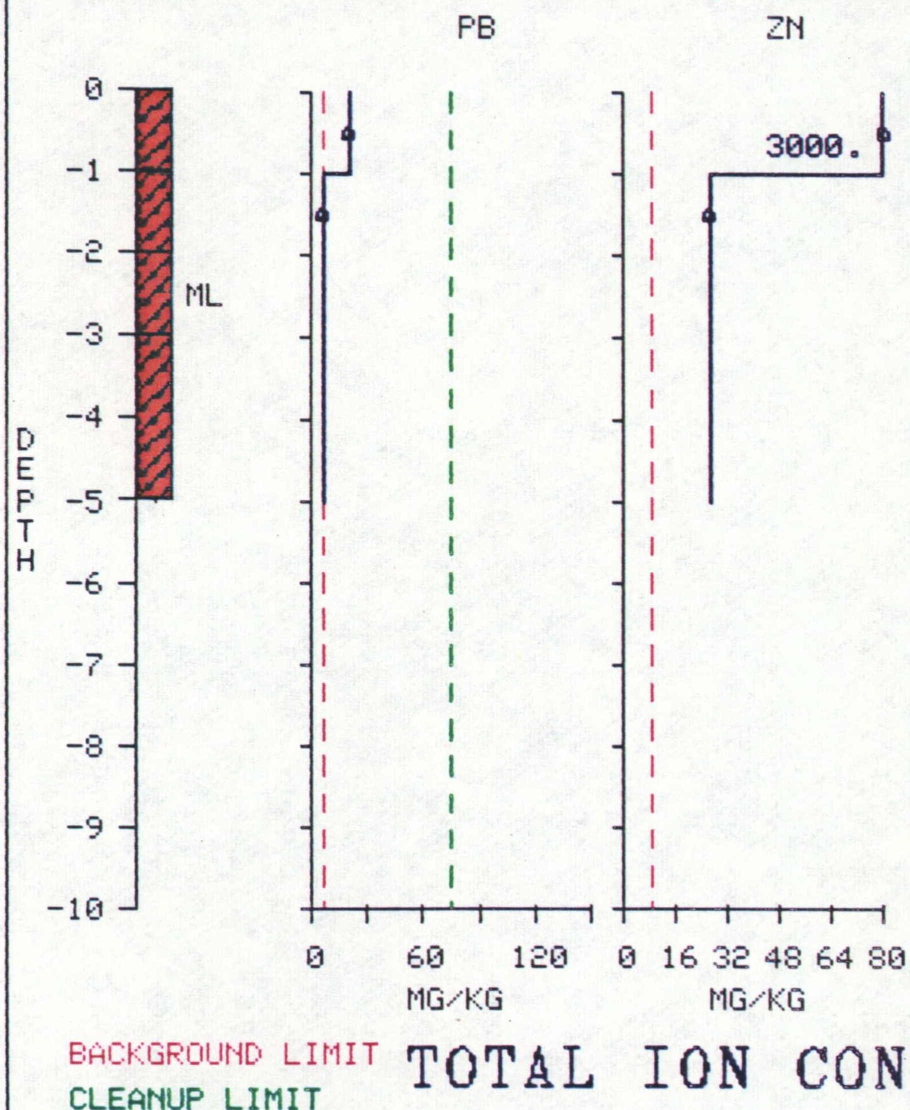


TOTAL ION CONCENTRATION

SITE 23
HOLE 8.

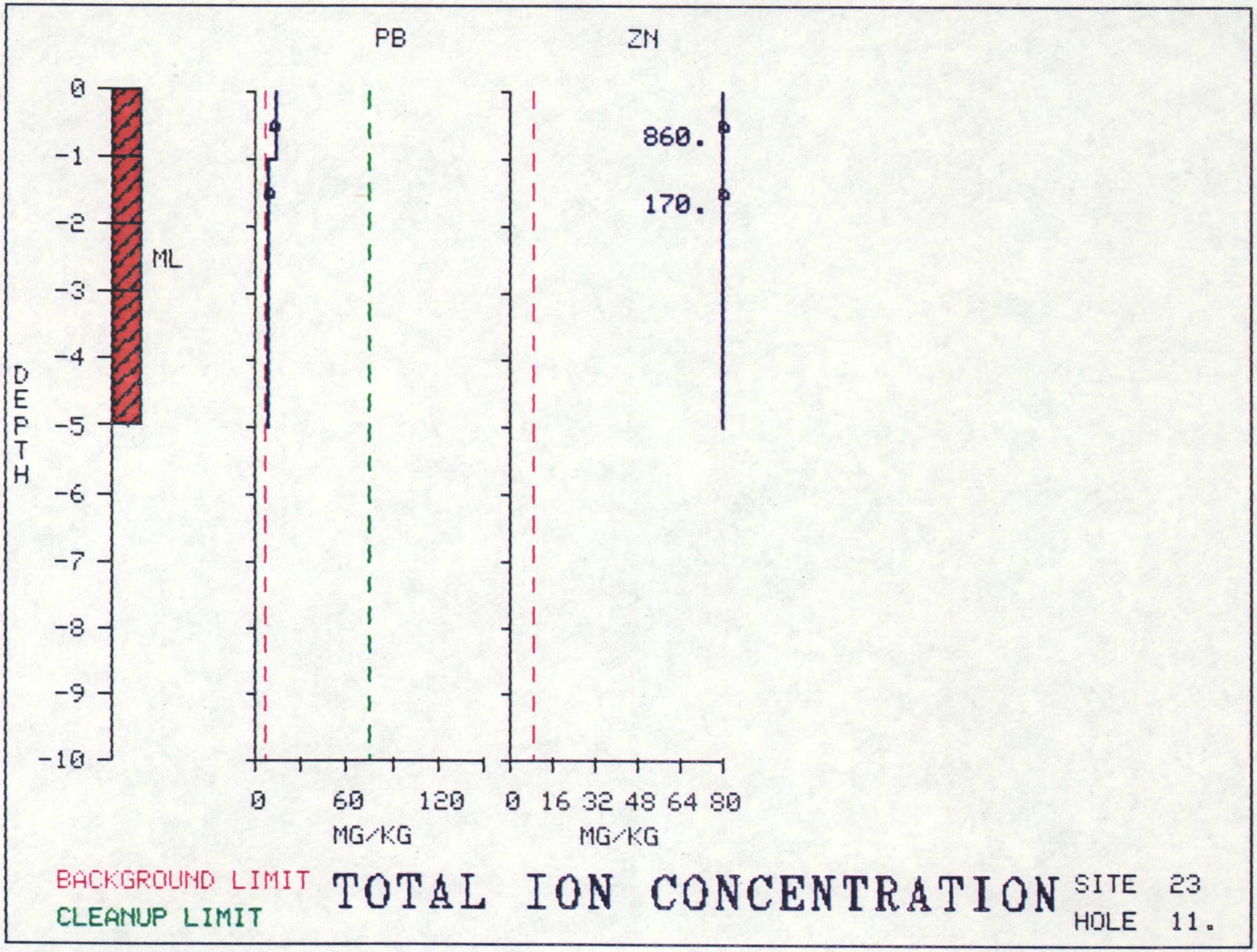


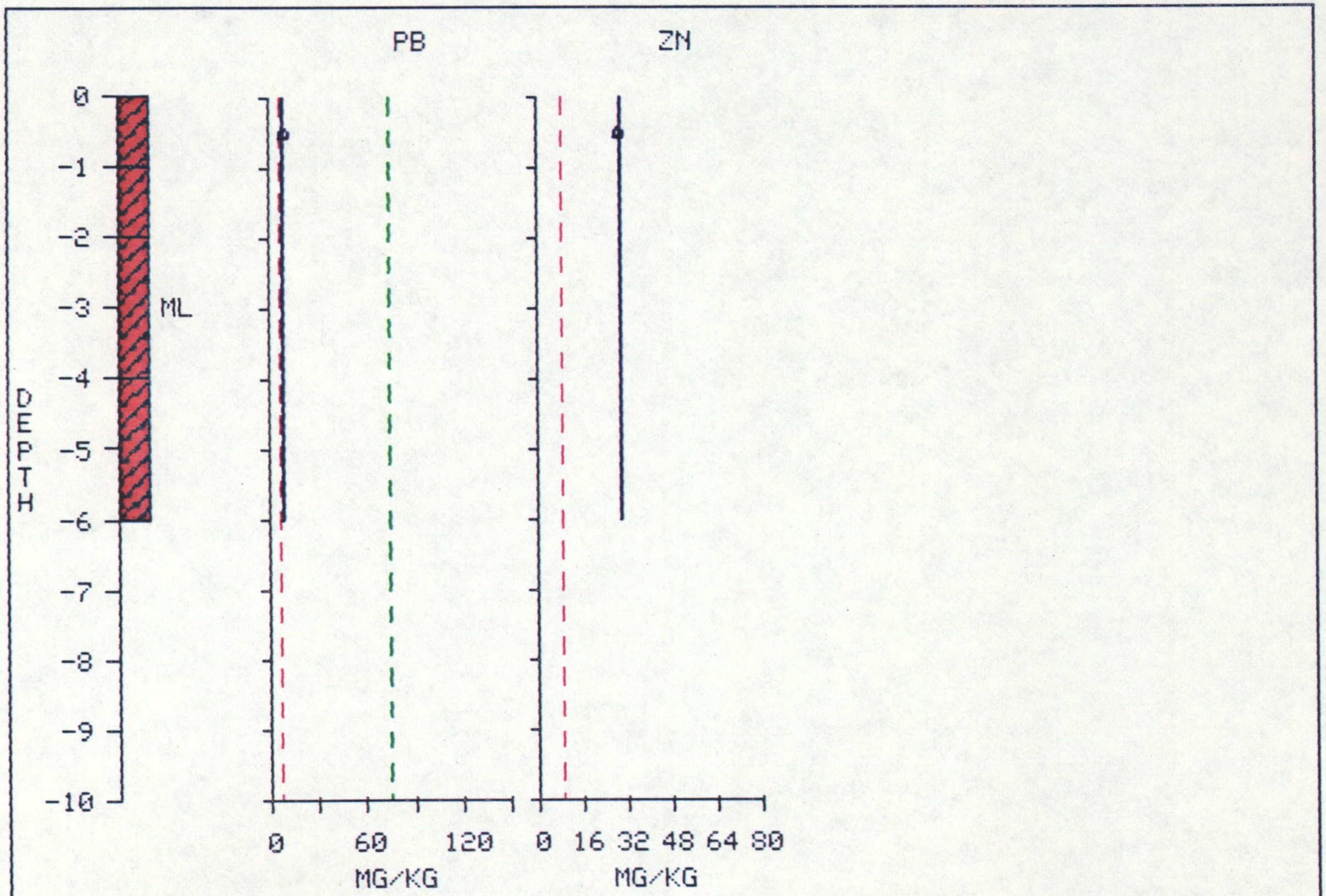
PB
ZN
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
DEPTH
ML
520.
2200.
550.
0
60
120
MG/KG
0
16
32
48
64
80
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 9.



TOTAL ION CONCENTRATION

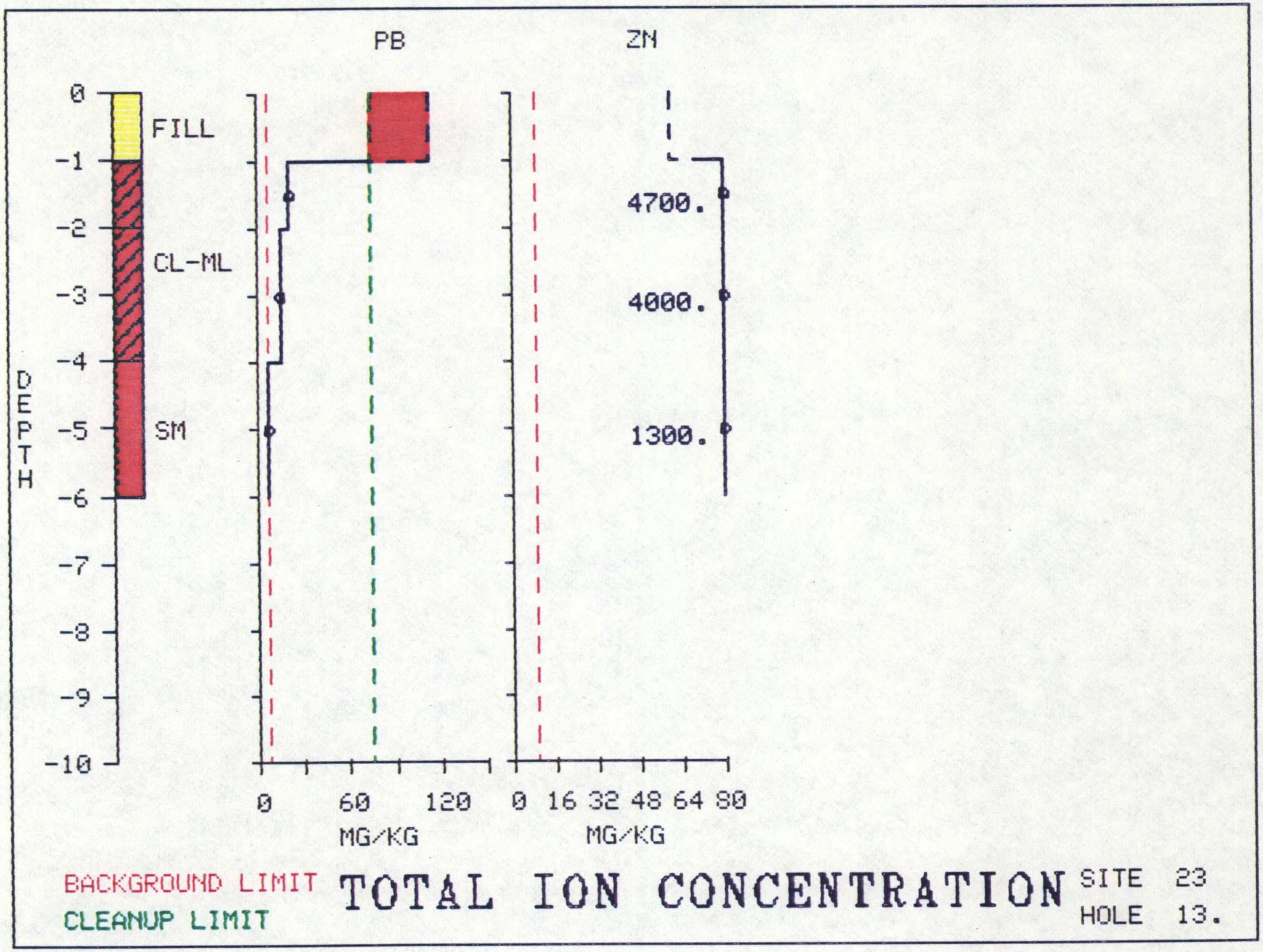
SITE 23
HOLE 10.


PB
ZN
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
DEPTH
ML
860.
170.
0
60
120
MG/KG
0
16
32
48
64
80
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 11.

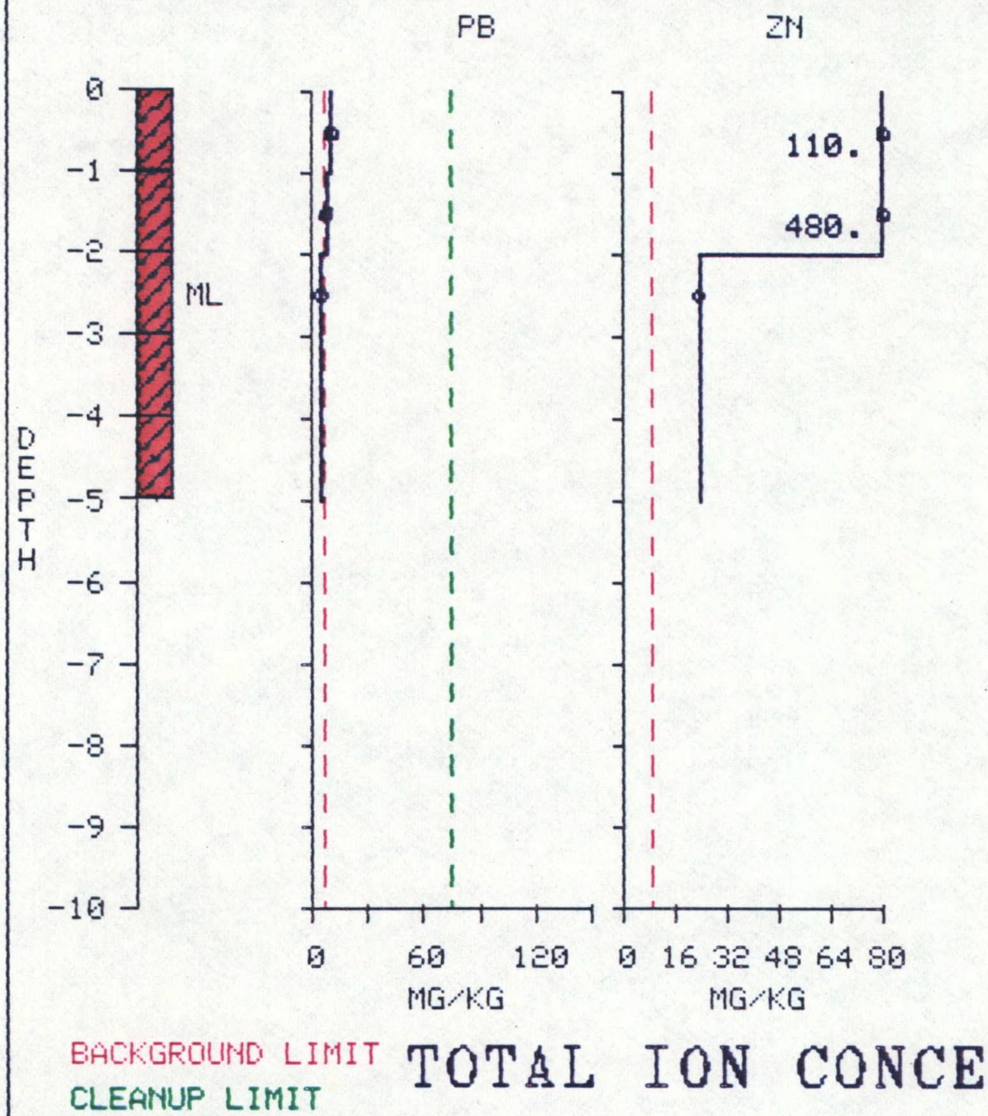


TOTAL ION CONCENTRATION

SITE 23
HOLE 12.

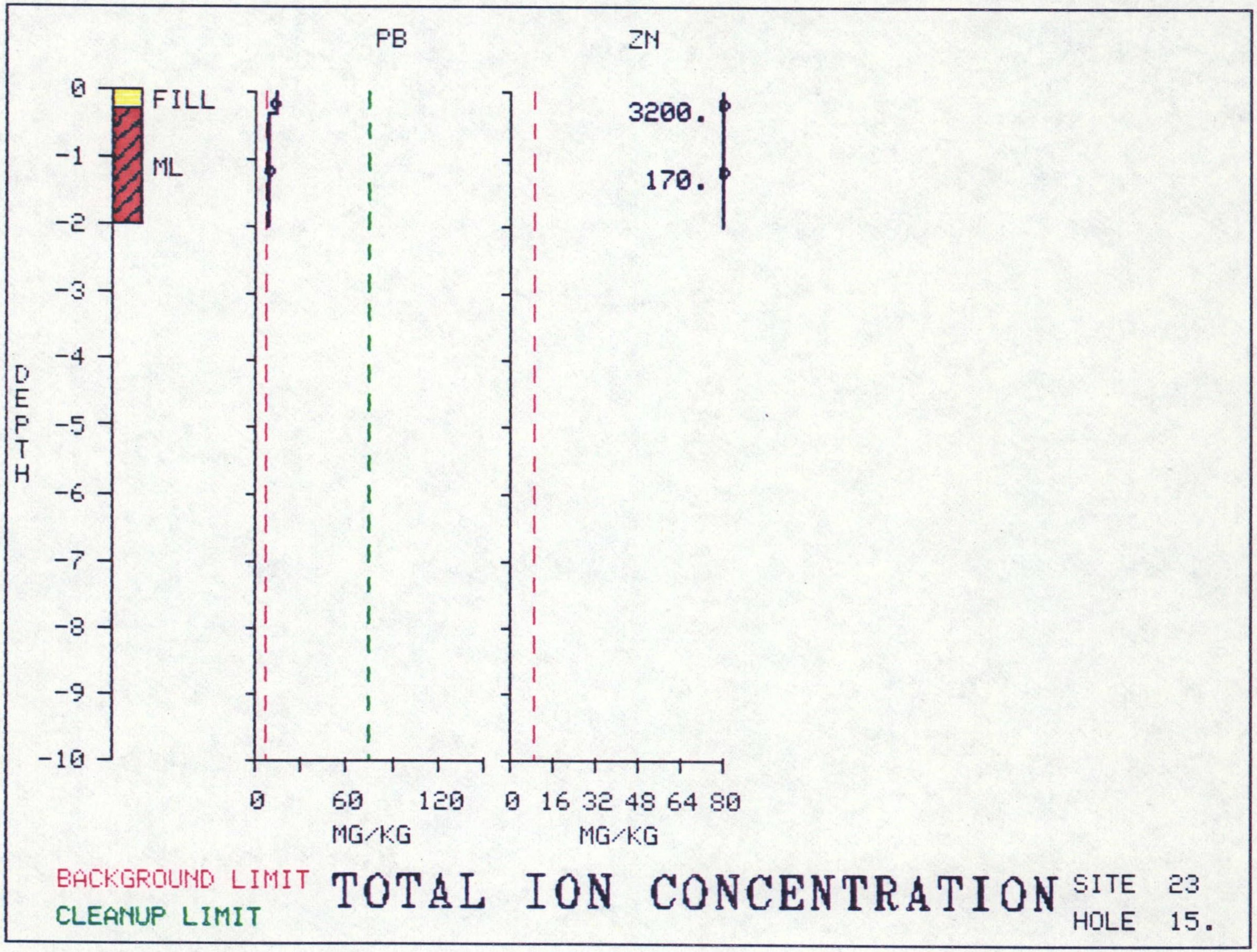


TOTAL ION CONCENTRATION

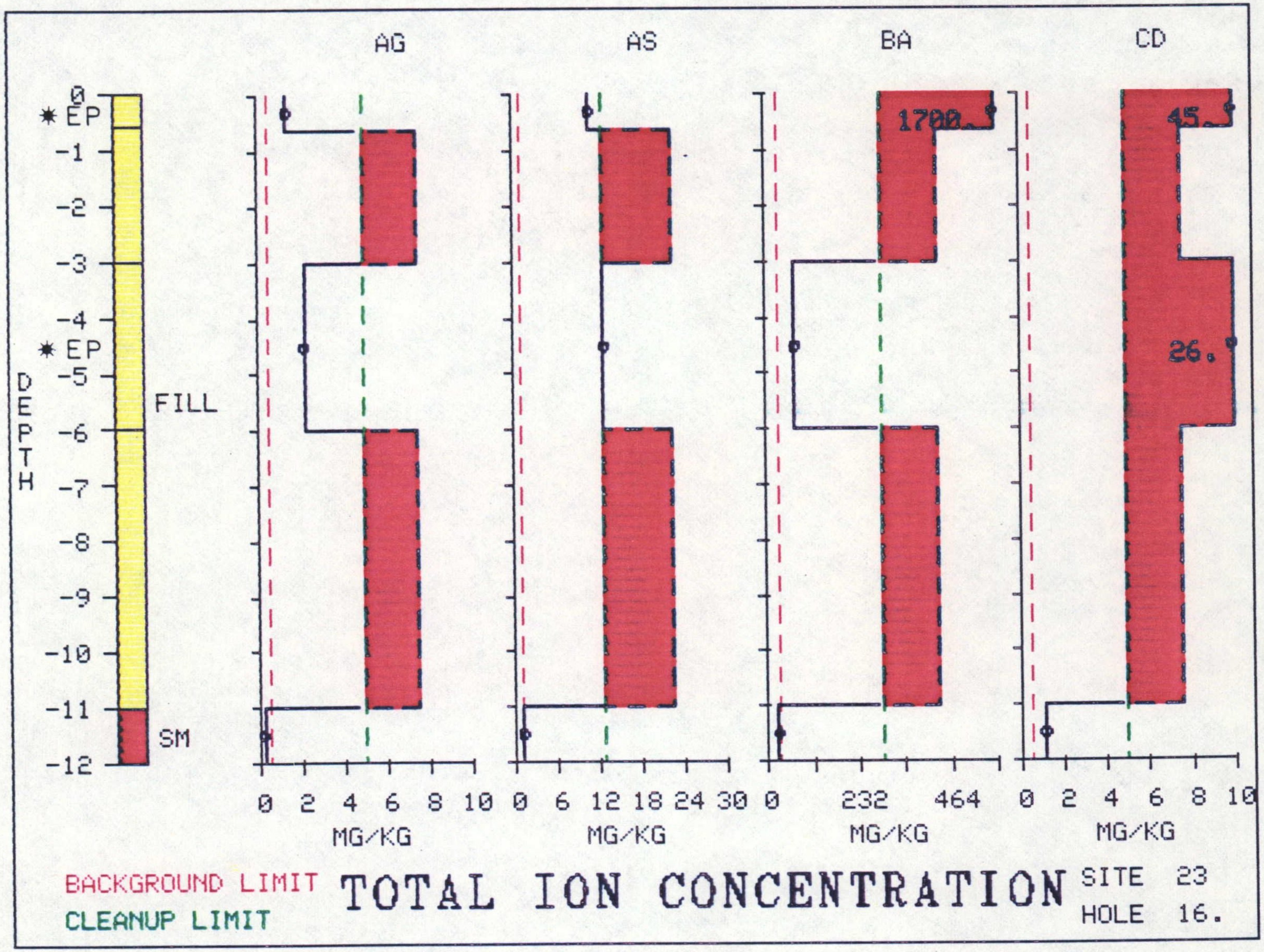


TOTAL ION CONCENTRATION

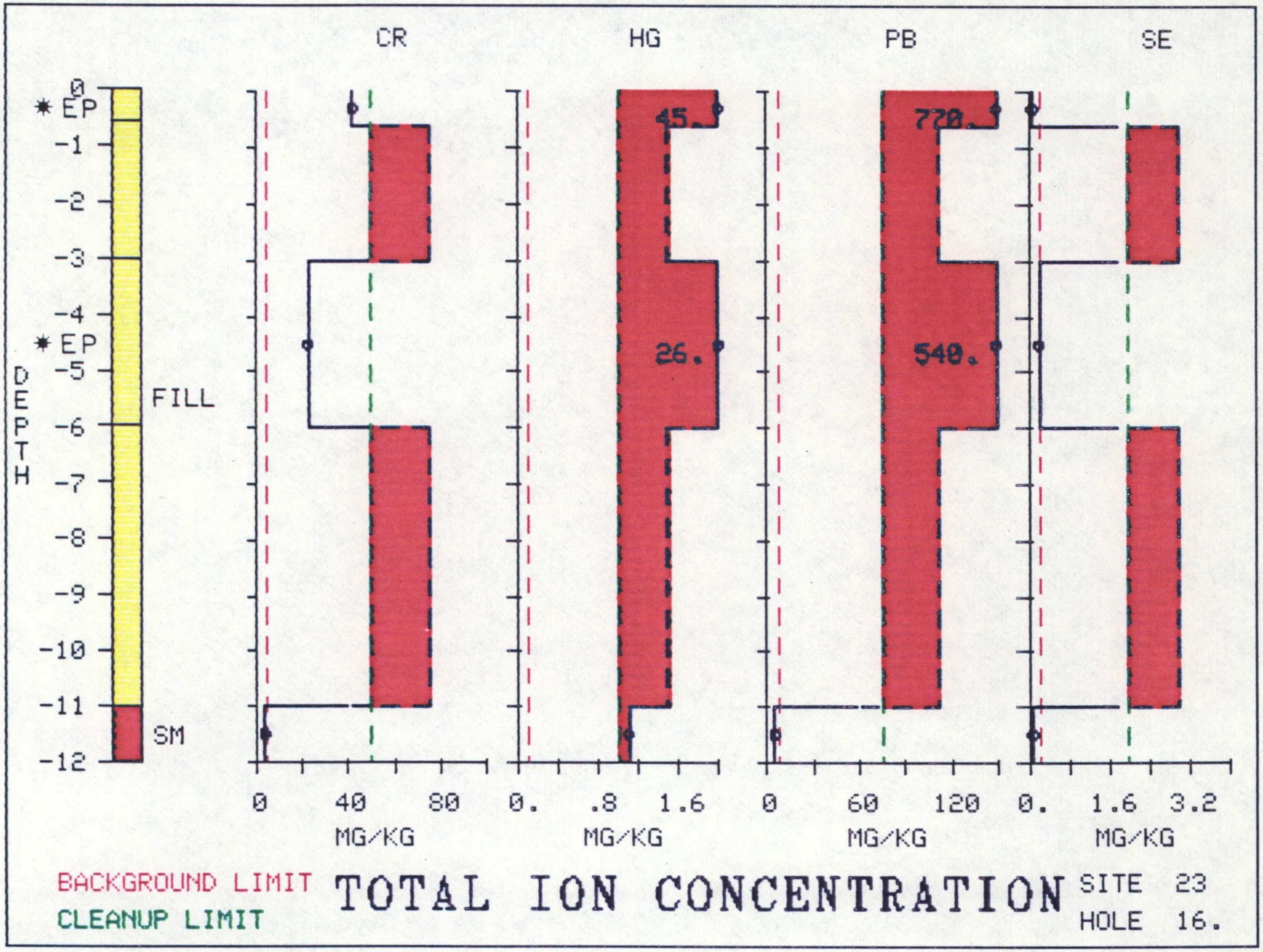
SITE 23
HOLE 14.



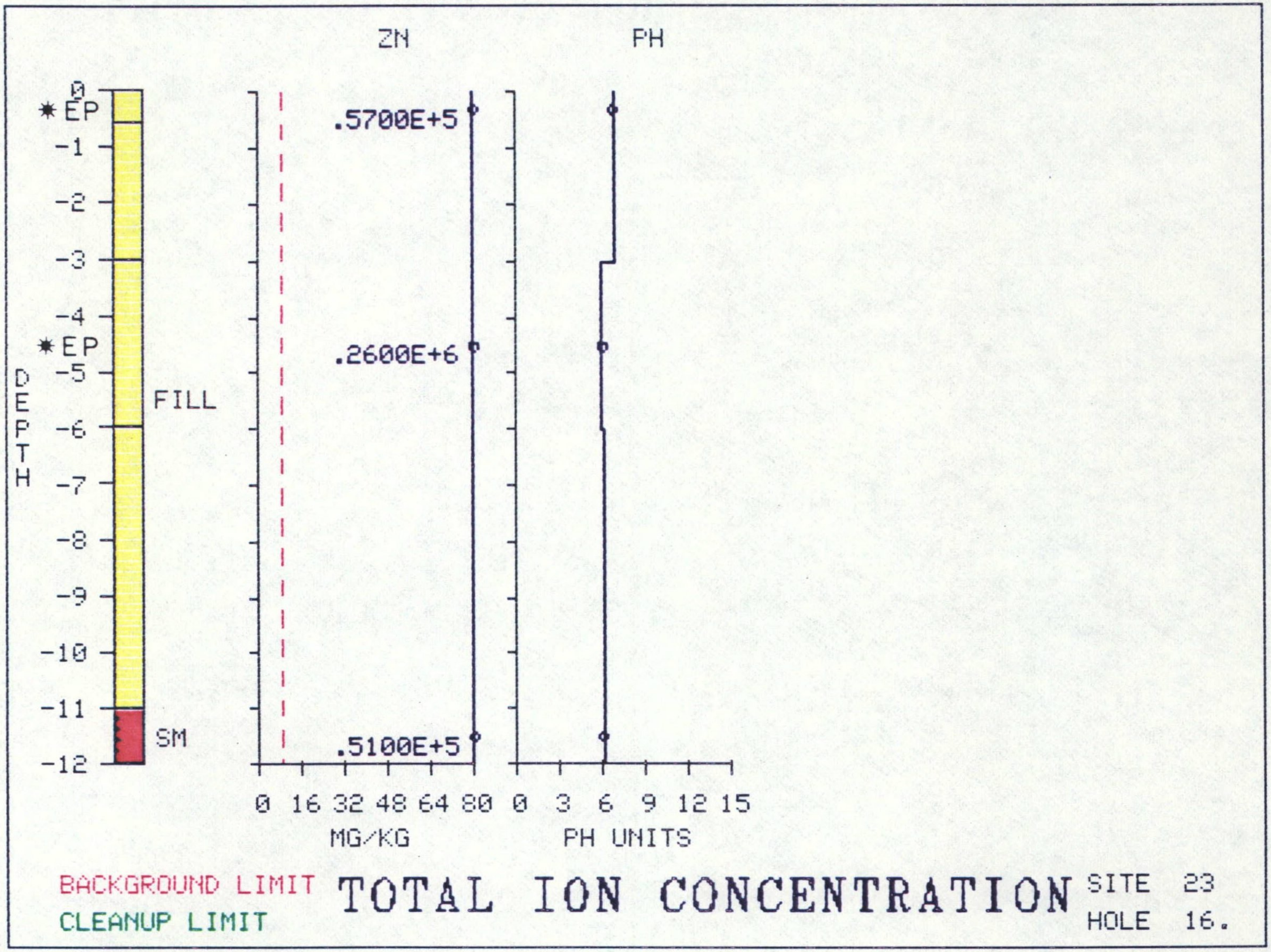
PB
ZN
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
DEPTH
FILL
ML
3200.
170.
0 60 120
MG/KG
0 16 32 48 64 80
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 15.



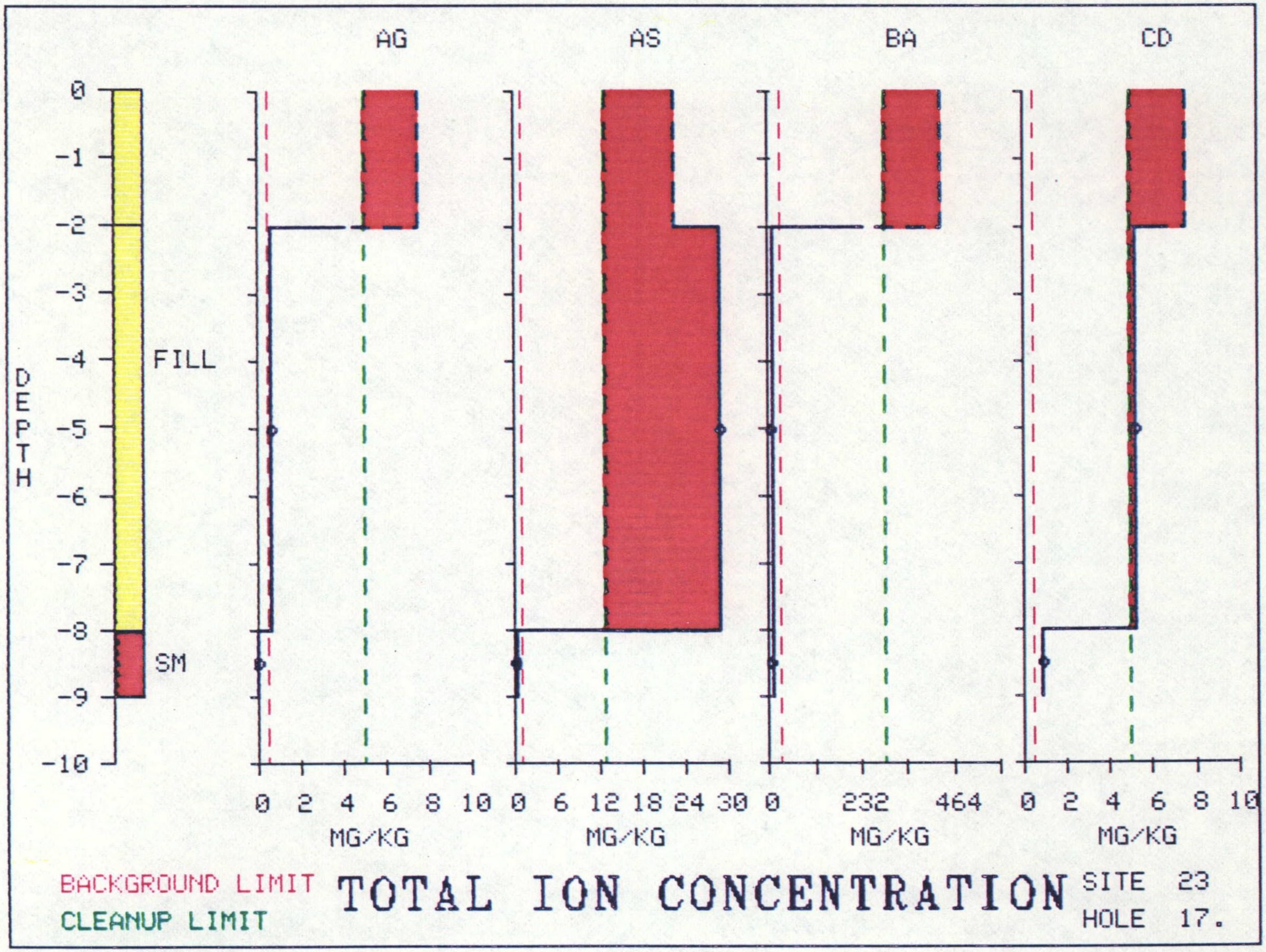
AG
AS
BA
CD
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
* EP
* EP
DEPTH
FILL
SM
1700.
45.
26.
0 2 4 6 8 10
MG/KG
0 6 12 18 24 30
MG/KG
0 232 464
MG/KG
0 2 4 6 8 10
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 16.

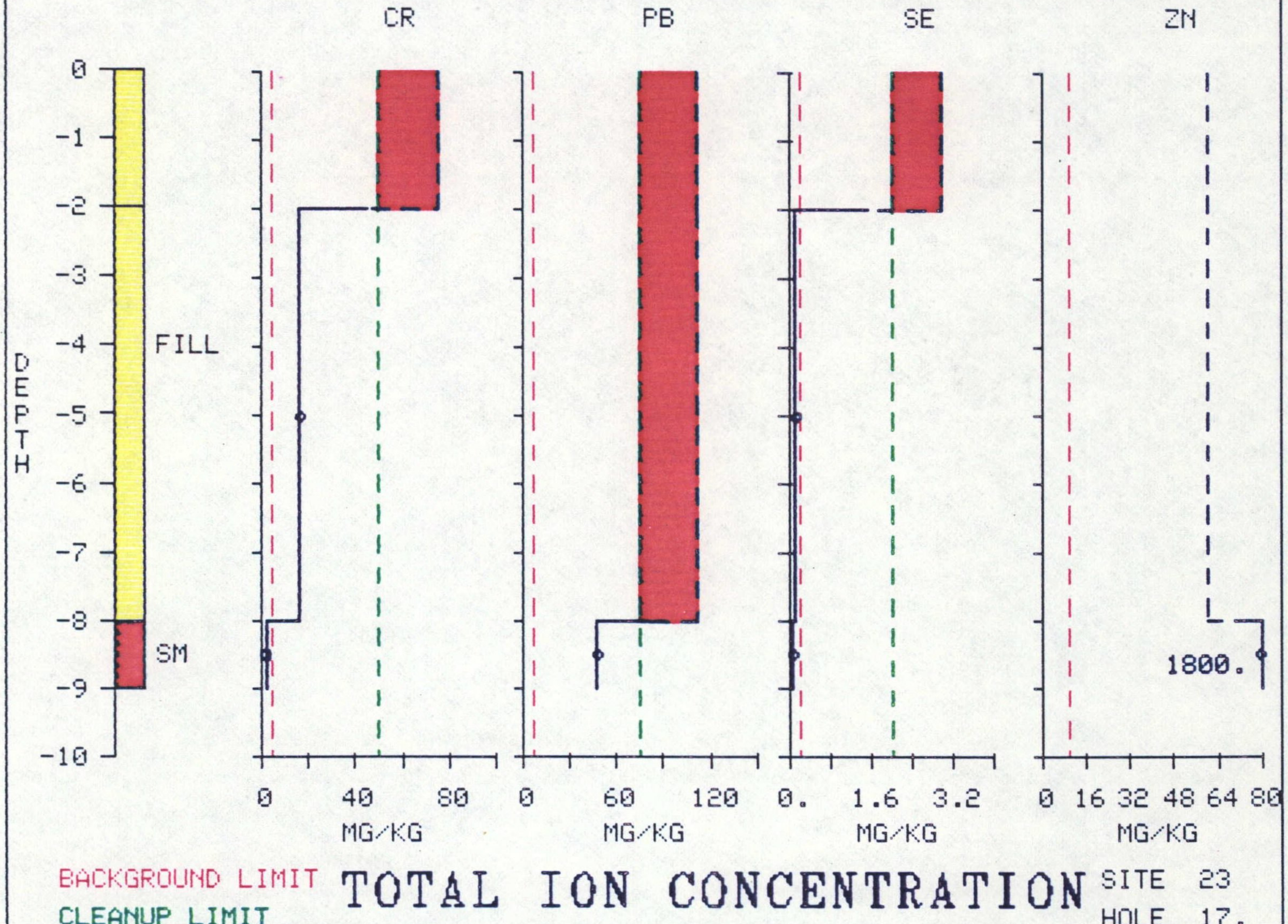


CR
HG
PB
SE
0
* EP
-1
-2
-3
-4
* EP
-5
-6
-7
-8
-9
-10
-11
-12
DEPTH
FILL
SM
45.
26.
720.
540.
0
40
80
MG/KG
0.
.8
1.6
MG/KG
0
60
120
MG/KG
0.
1.6
3.2
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 16.



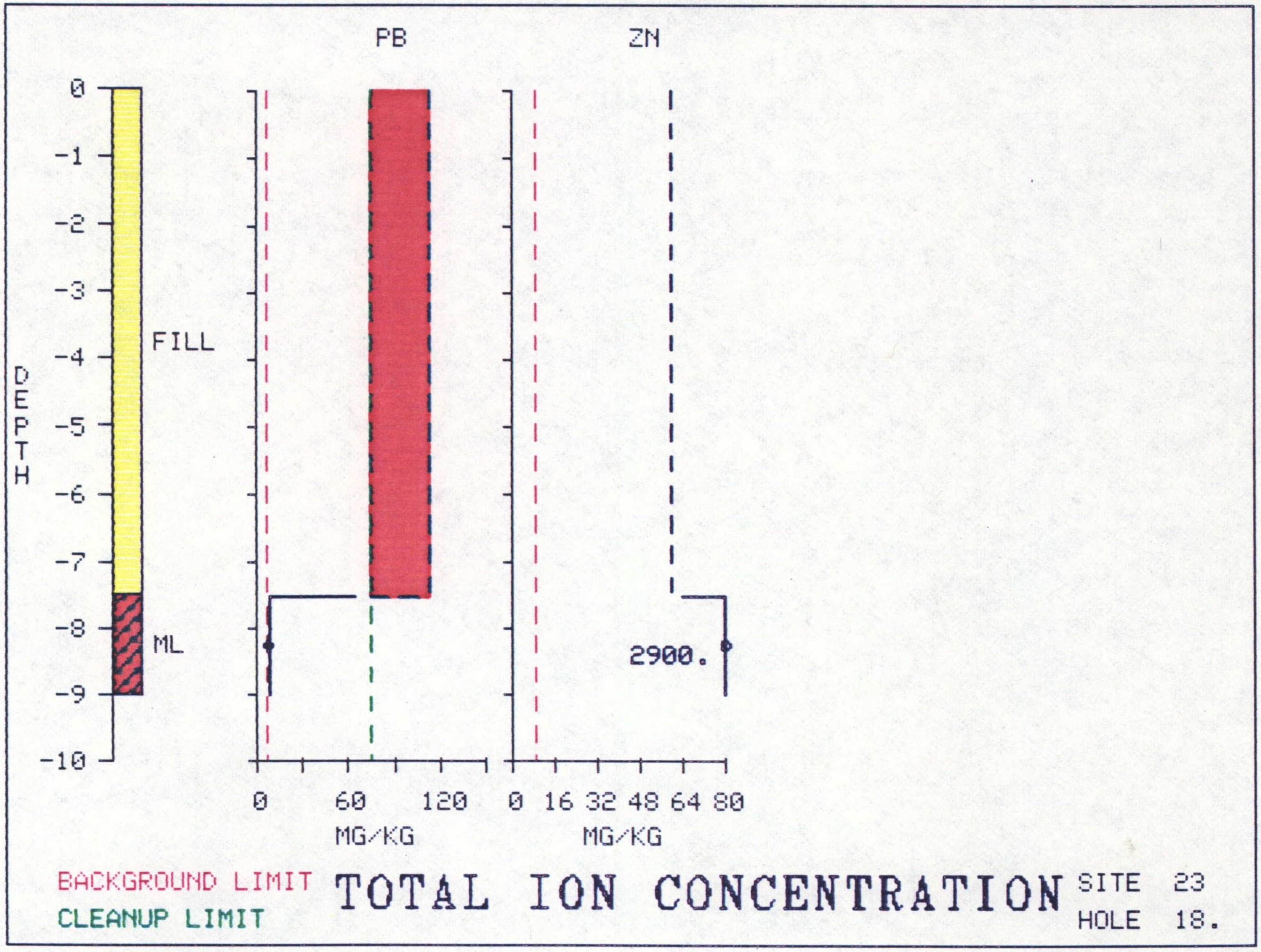
ZN
PH
0
* EP
-1
-2
-3
-4
* EP
-5
-6
-7
-8
-9
-10
-11
-12
DEPTH
FILL
SM
.5700E+5
.2600E+6
.5100E+5
0 16 32 48 64 80
MG/KG
0 3 6 9 12 15
PH UNITS
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 16.


AG
AS
BA
CD
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
DEPTH
FILL
SM
0 2 4 6 8 10
0 6 12 18 24 30
0 232 464
0 2 4 6 8 10
MG/KG
MG/KG
MG/KG
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 17.

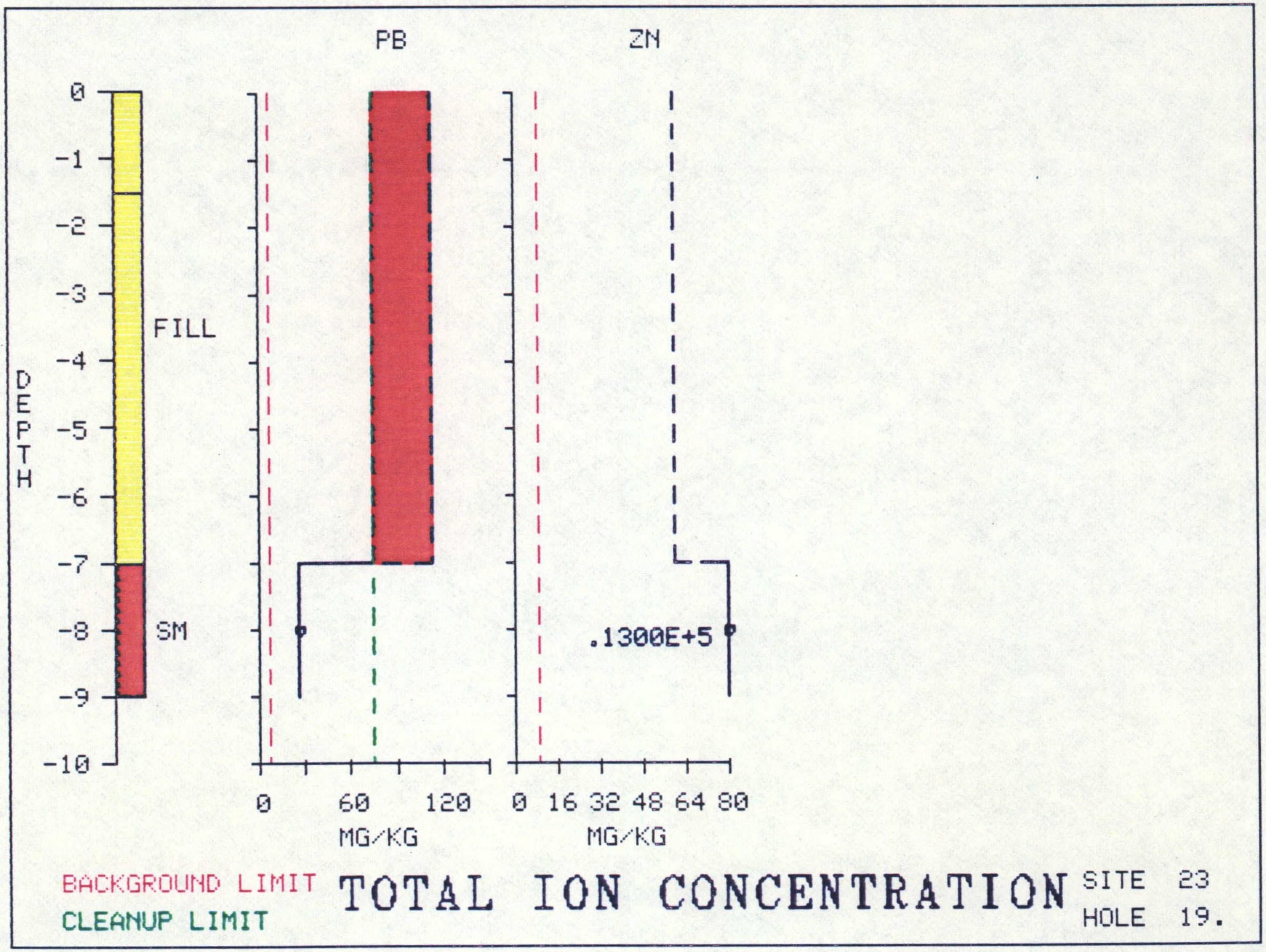


TOTAL ION CONCENTRATION

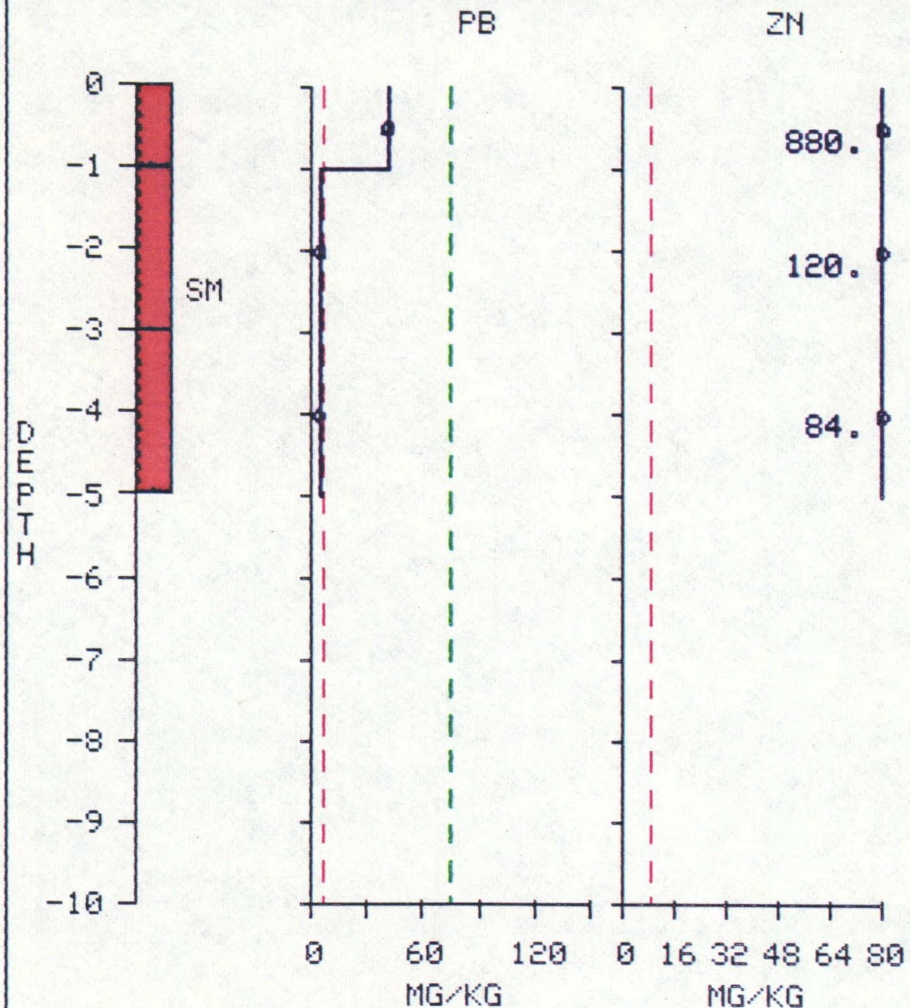
SITE 23
HOLE 17.



PB
ZN
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
DEPTH
FILL
ML
2900.
0 60 120
MG/KG
0 16 32 48 64 80
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 18.



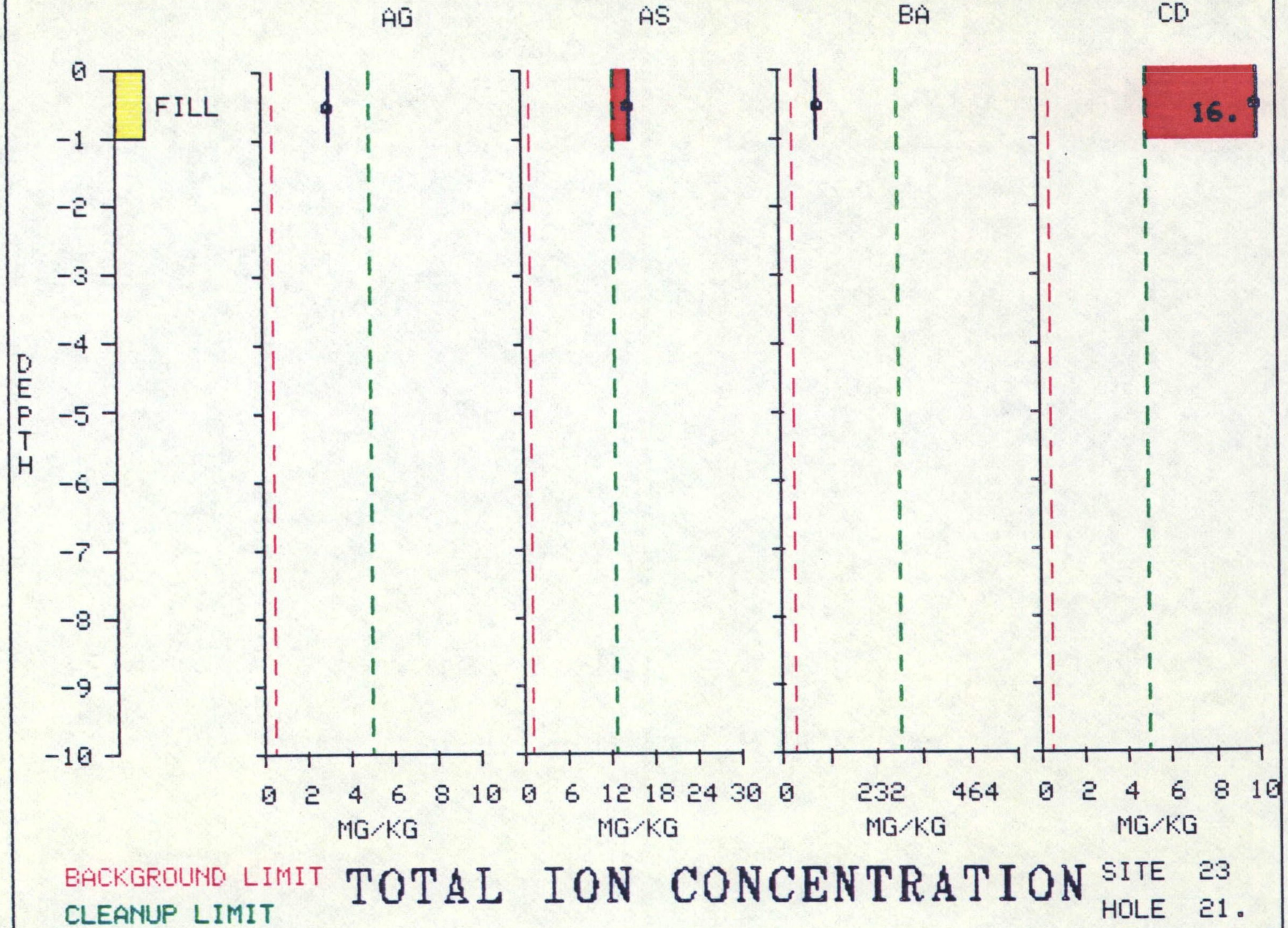
PB
ZN
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
DEPTH
FILL
SM
.1300E+5
0
60
120
MG/KG
0
16
32
48
64
80
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 19.



BACKGROUND LIMIT
CLEANUP LIMIT

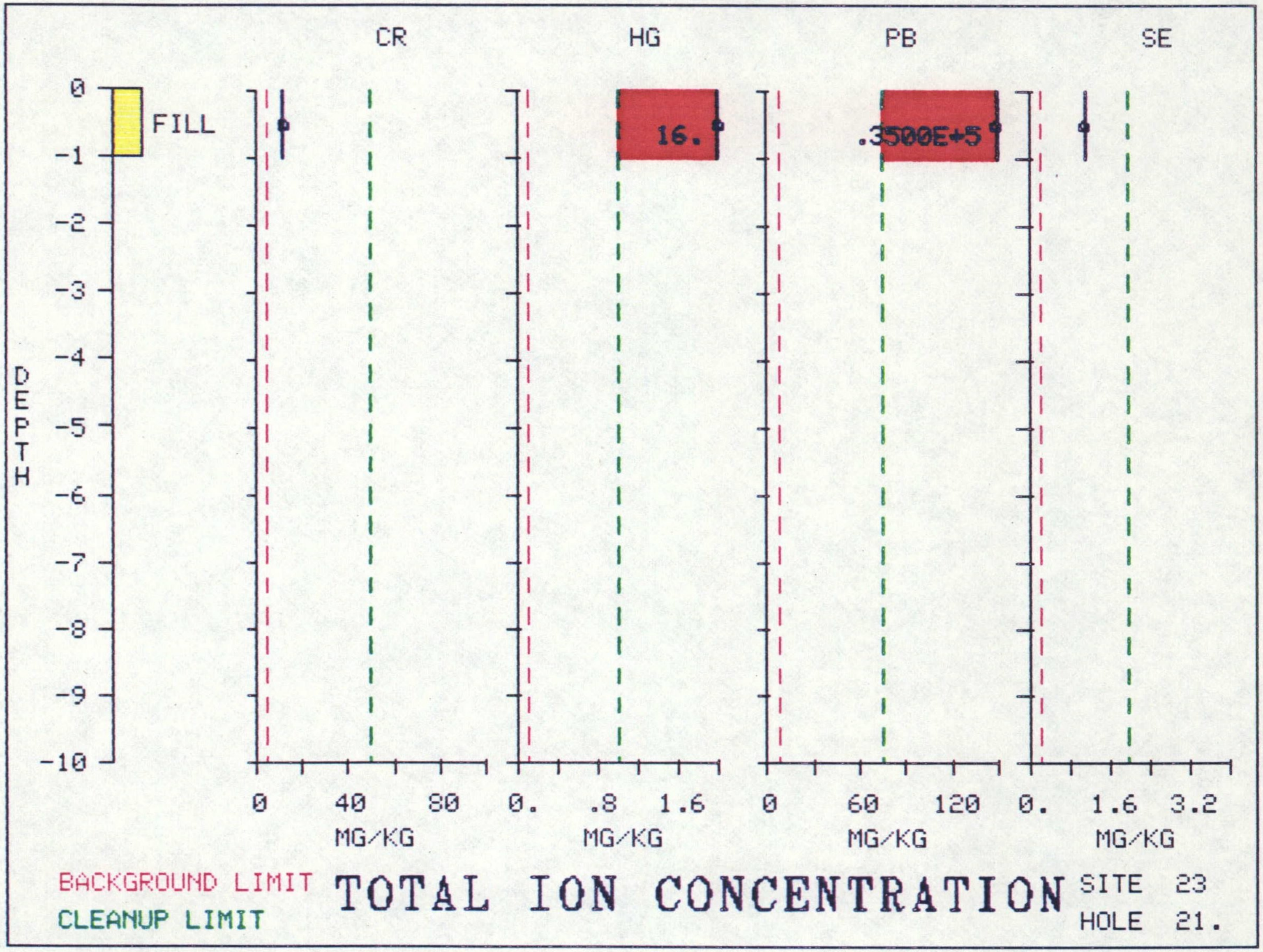
TOTAL ION CONCENTRATION

SITE 23
HOLE 20.

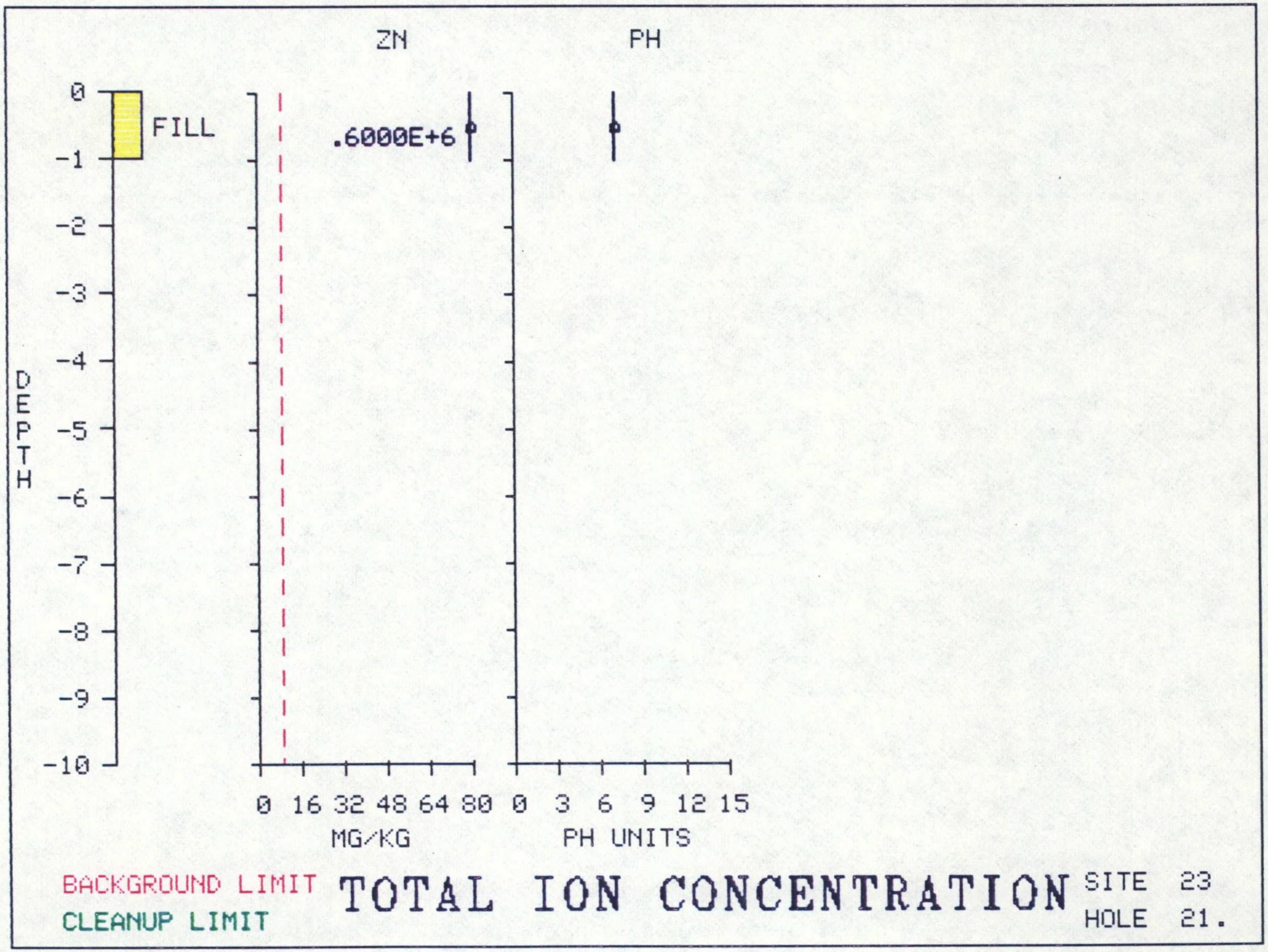


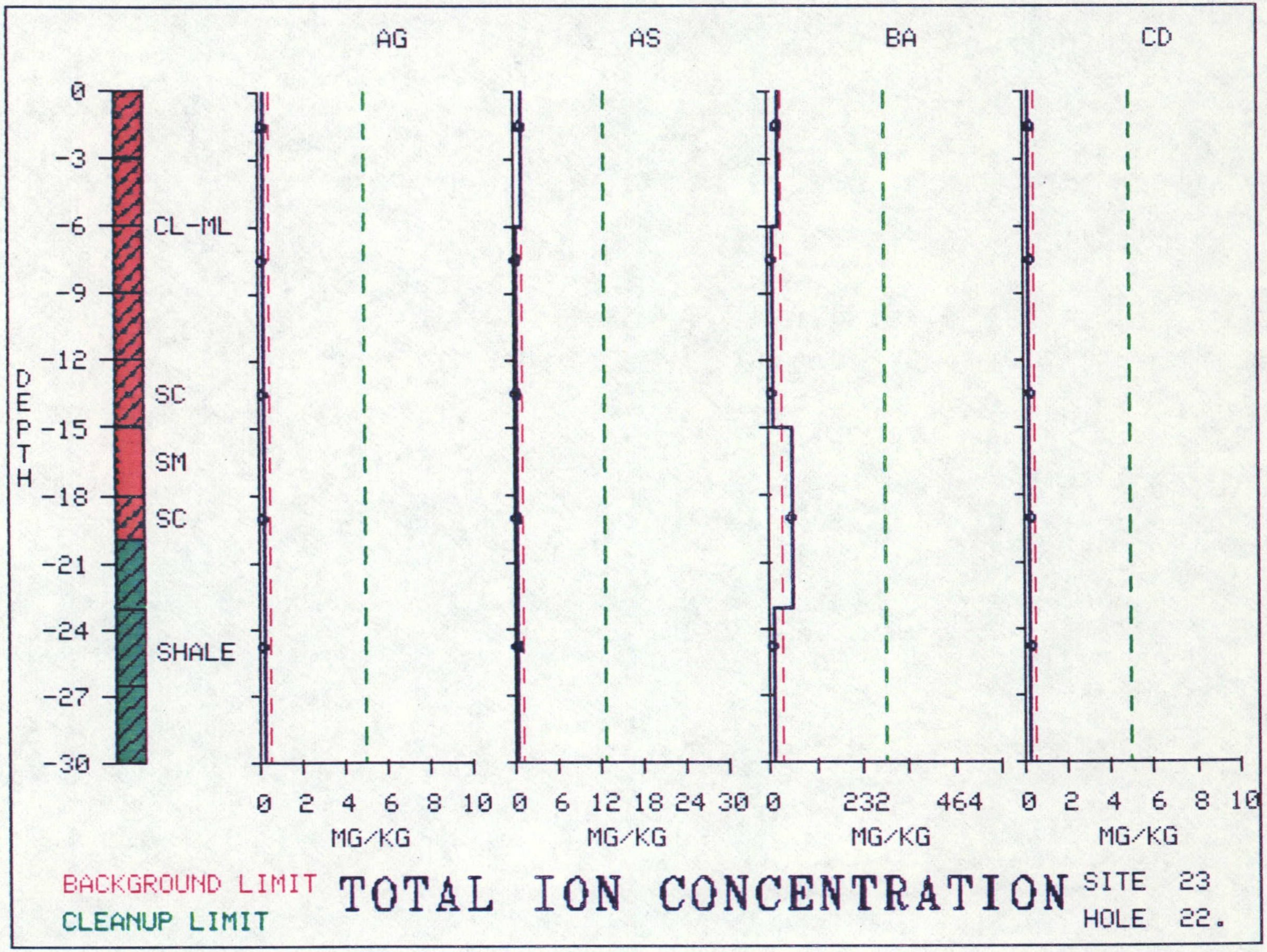
TOTAL ION CONCENTRATION

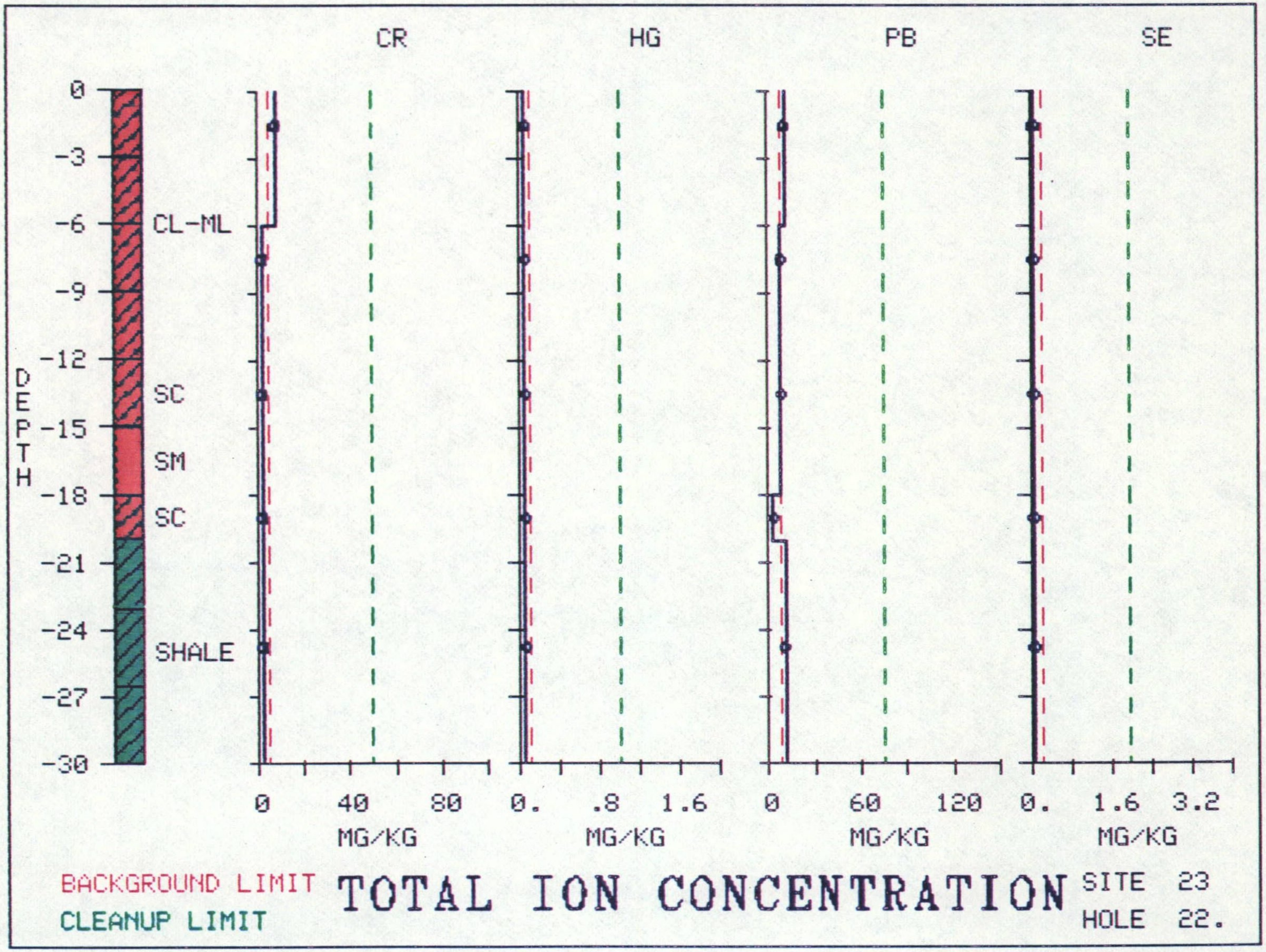
SITE 23
HOLE 21.

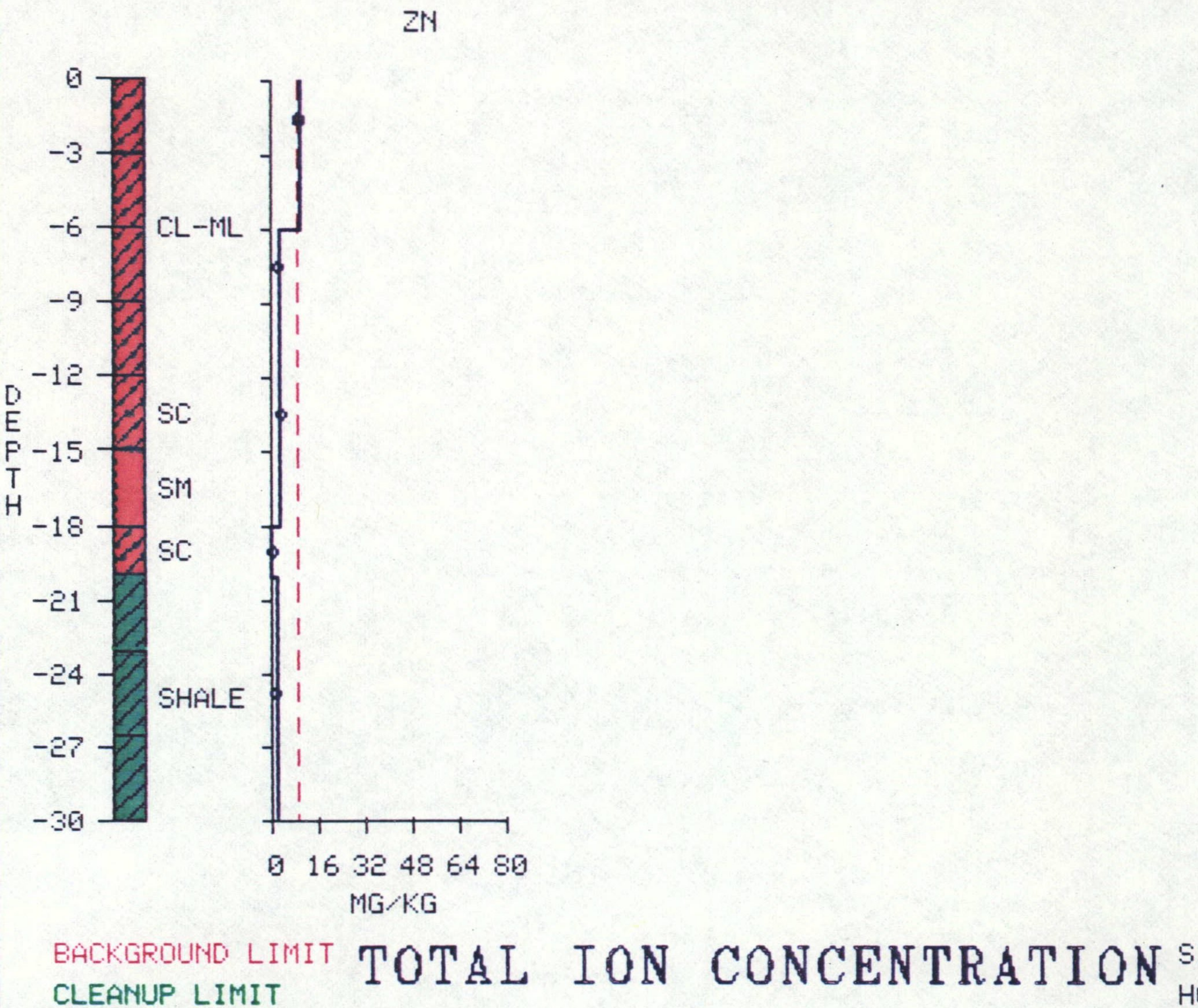


CR
HG
PB
SE
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
DEPTH
FILL
16.
.3500E+5
0
40
80
0.
.8
1.6
0
60
120
0.
1.6
3.2
MG/KG
MG/KG
MG/KG
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 21.


ZN
PH
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
DEPTH
FILL
.6000E+6
0 16 32 48 64 80
MG/KG
0 3 6 9 12 15
PH UNITS
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 21.

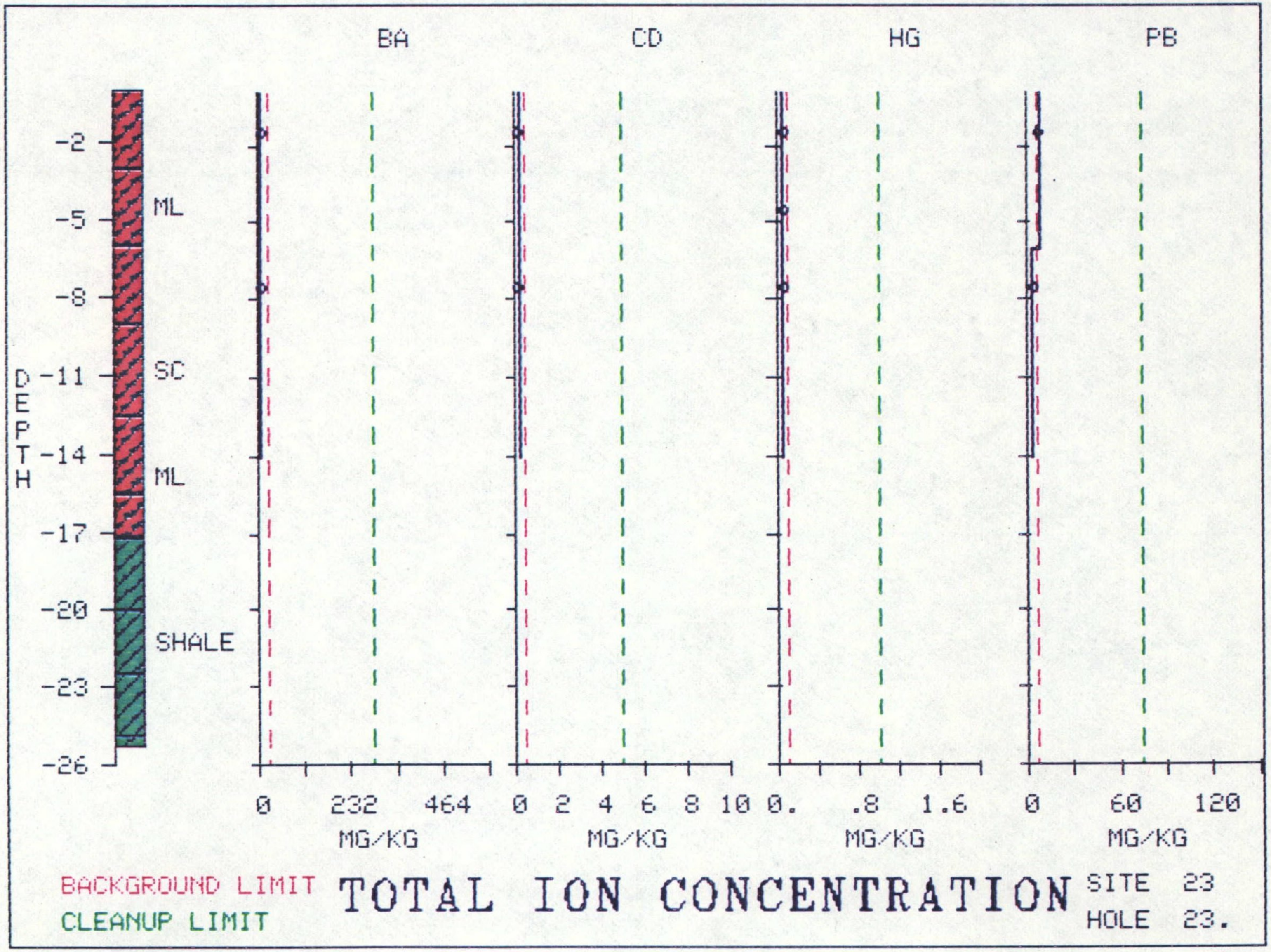

AG
AS
BA
CD
0
-3
-6
-9
-12
-15
-18
-21
-24
-27
-30
DEPTH
CL-ML
SC
SM
SC
SHALE
0 2 4 6 8 10
0 6 12 18 24 30
0 232 464
0 2 4 6 8 10
MG/KG
MG/KG
MG/KG
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 22.


CR
HG
PB
SE
0
-3
-6
-9
-12
-15
-18
-21
-24
-27
-30
DEPTH
CL-ML
SC
SM
SC
SHALE
0 40 80
MG/KG
0. .8 1.6
MG/KG
0 60 120
MG/KG
0. 1.6 3.2
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 22.

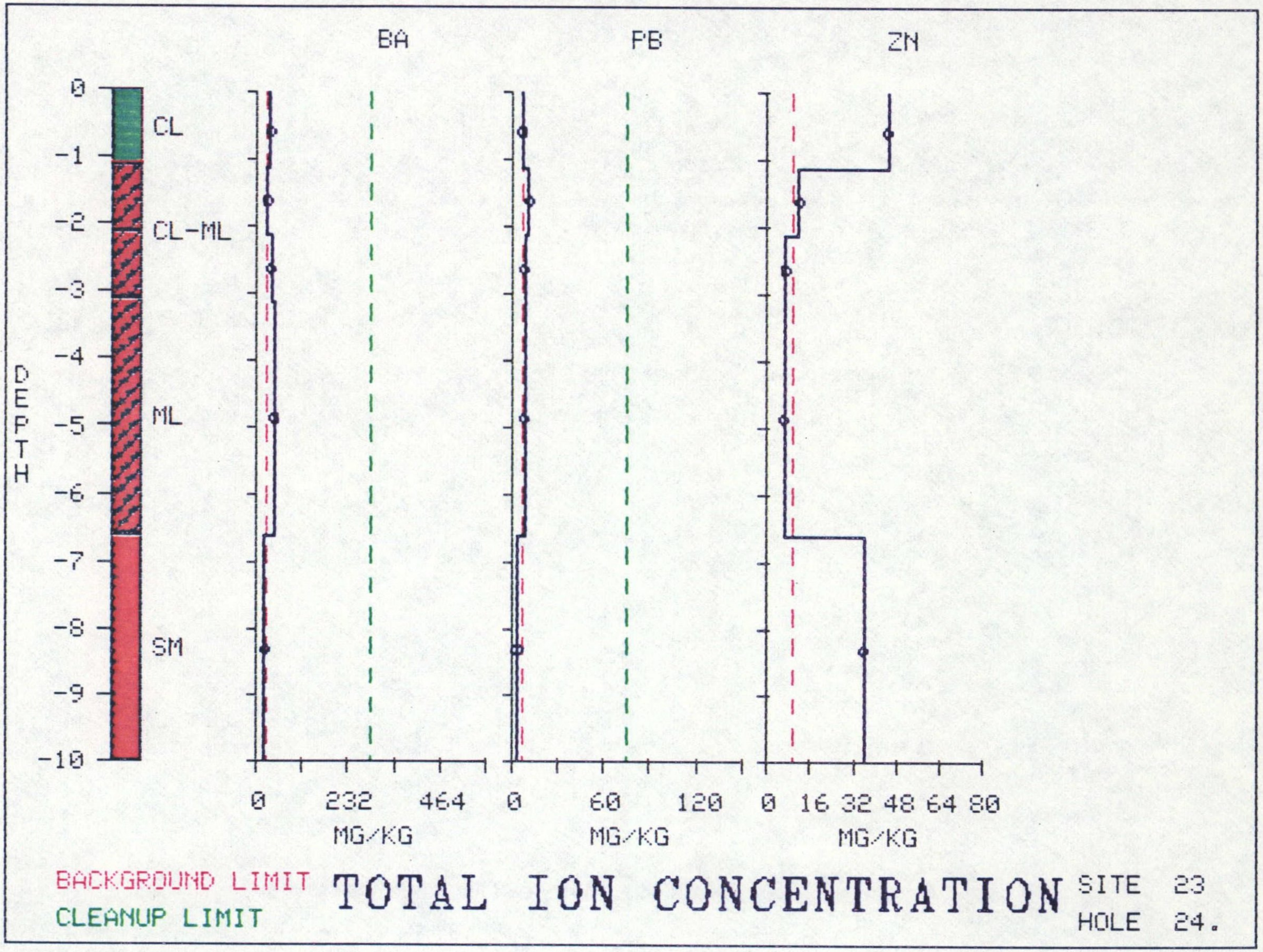


TOTAL ION CONCENTRATION

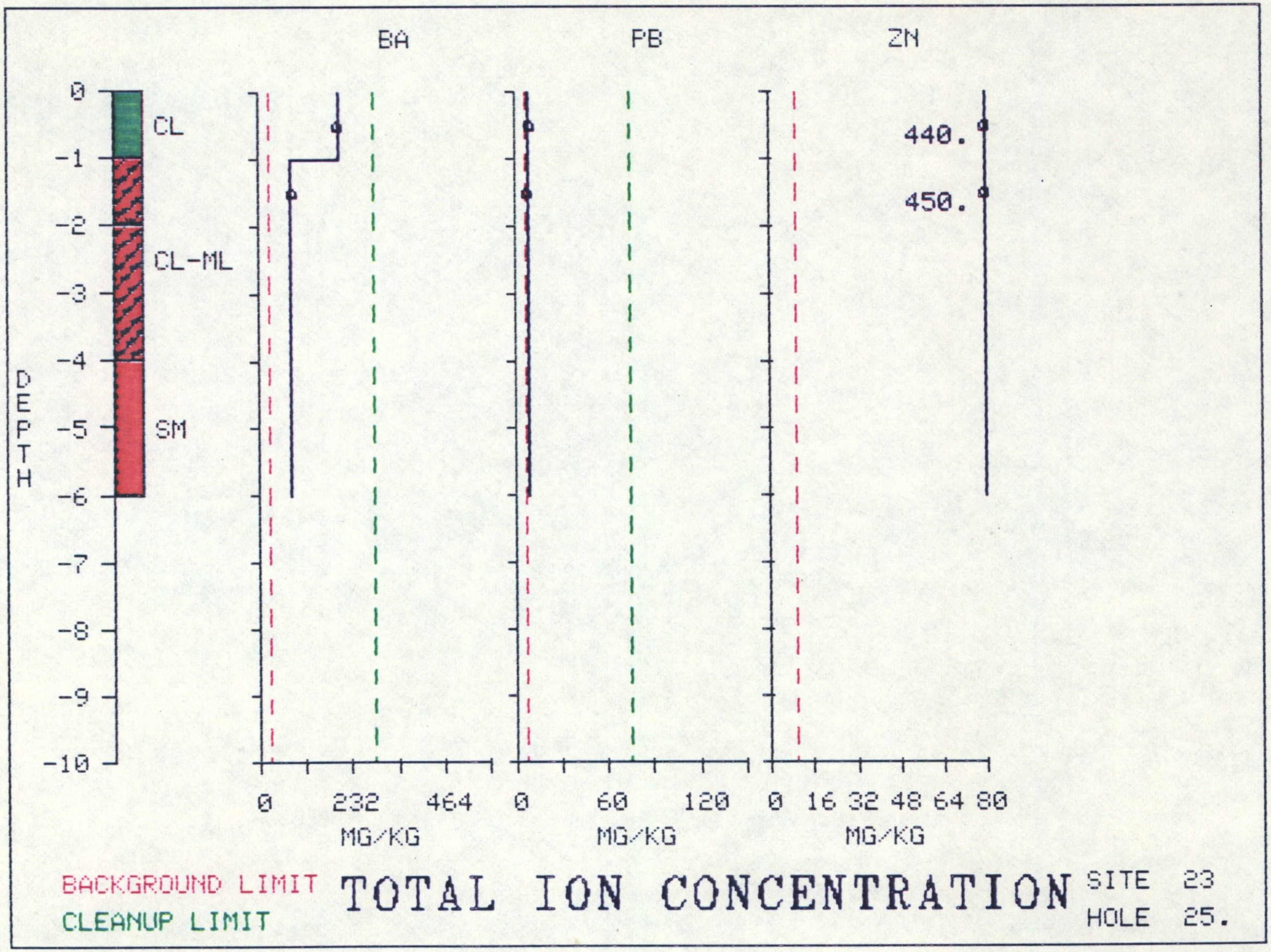
SITE 23
HOLE 22.



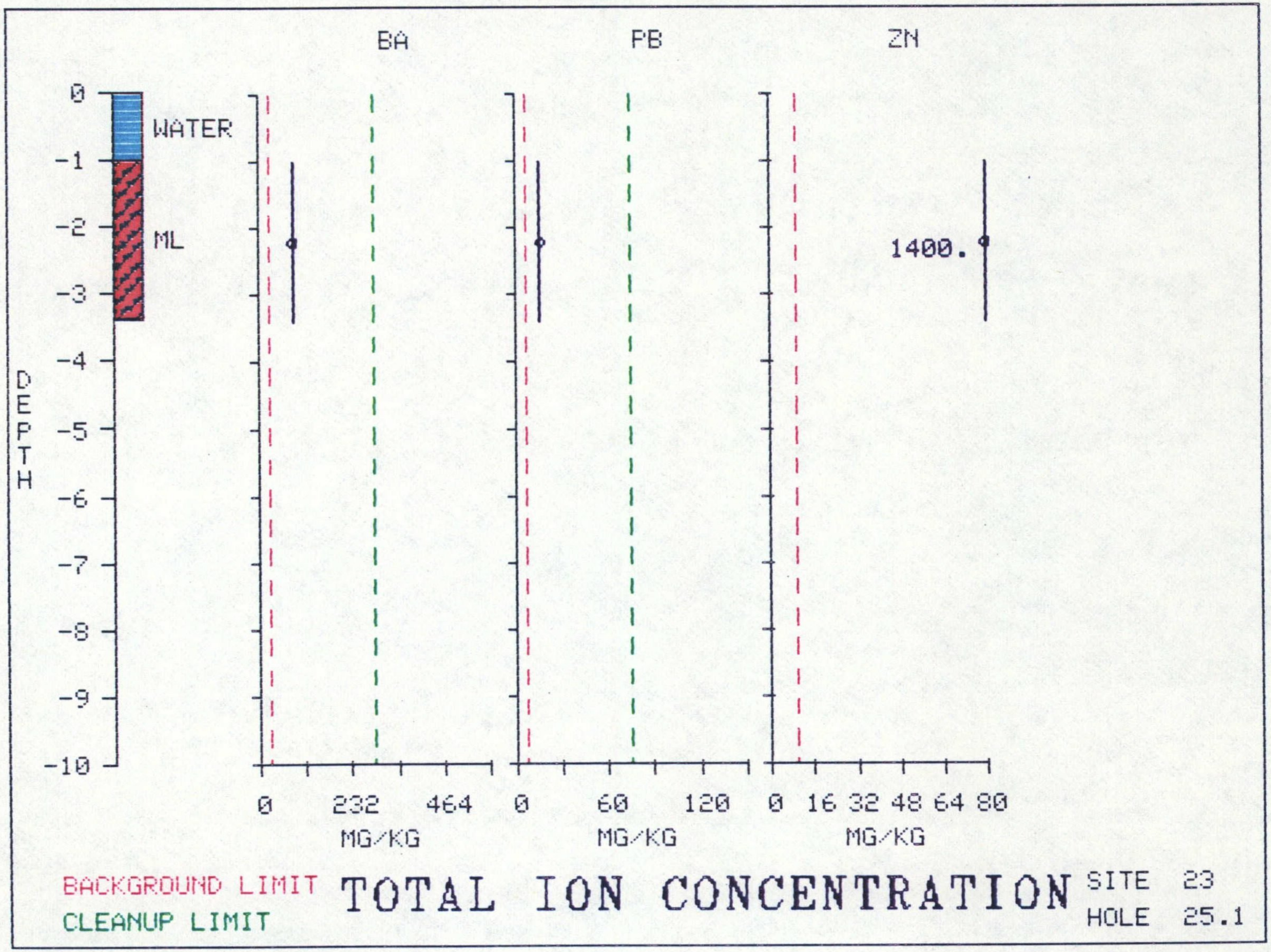
BA
CD
HG
PB
DEPTH
-2
-5
-8
-11
-14
-17
-20
-23
-26
ML
SC
ML
SHALE
0
232
464
0
2
4
6
8
10
0.
.8
1.6
0
60
120
MG/KG
MG/KG
MG/KG
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 23.

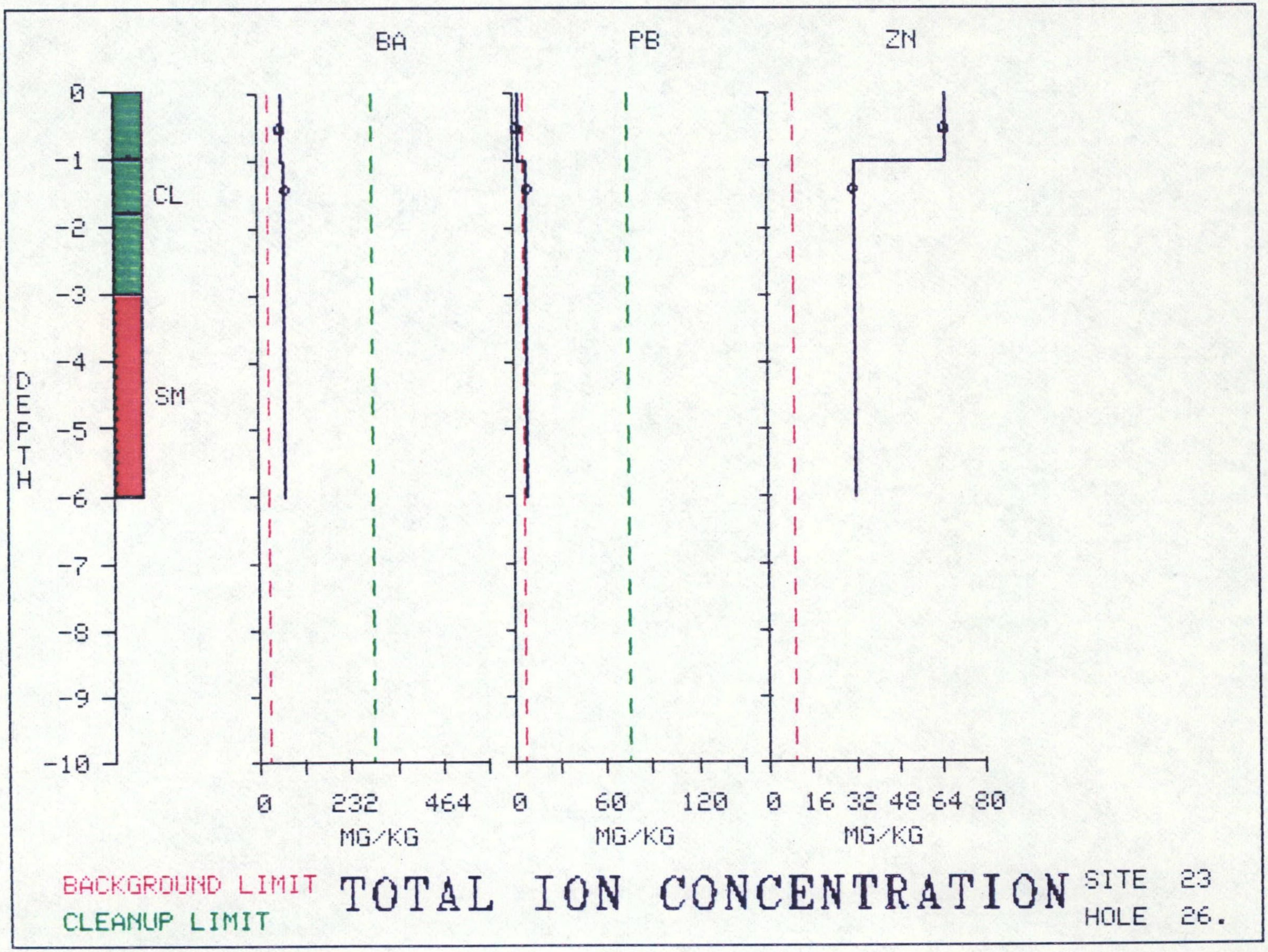


BA
PB
ZN
DEPTH
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
CL
CL-ML
ML
SM
0
232
464
MG/KG
0
60
120
MG/KG
0
16
32
48
64
80
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 24.

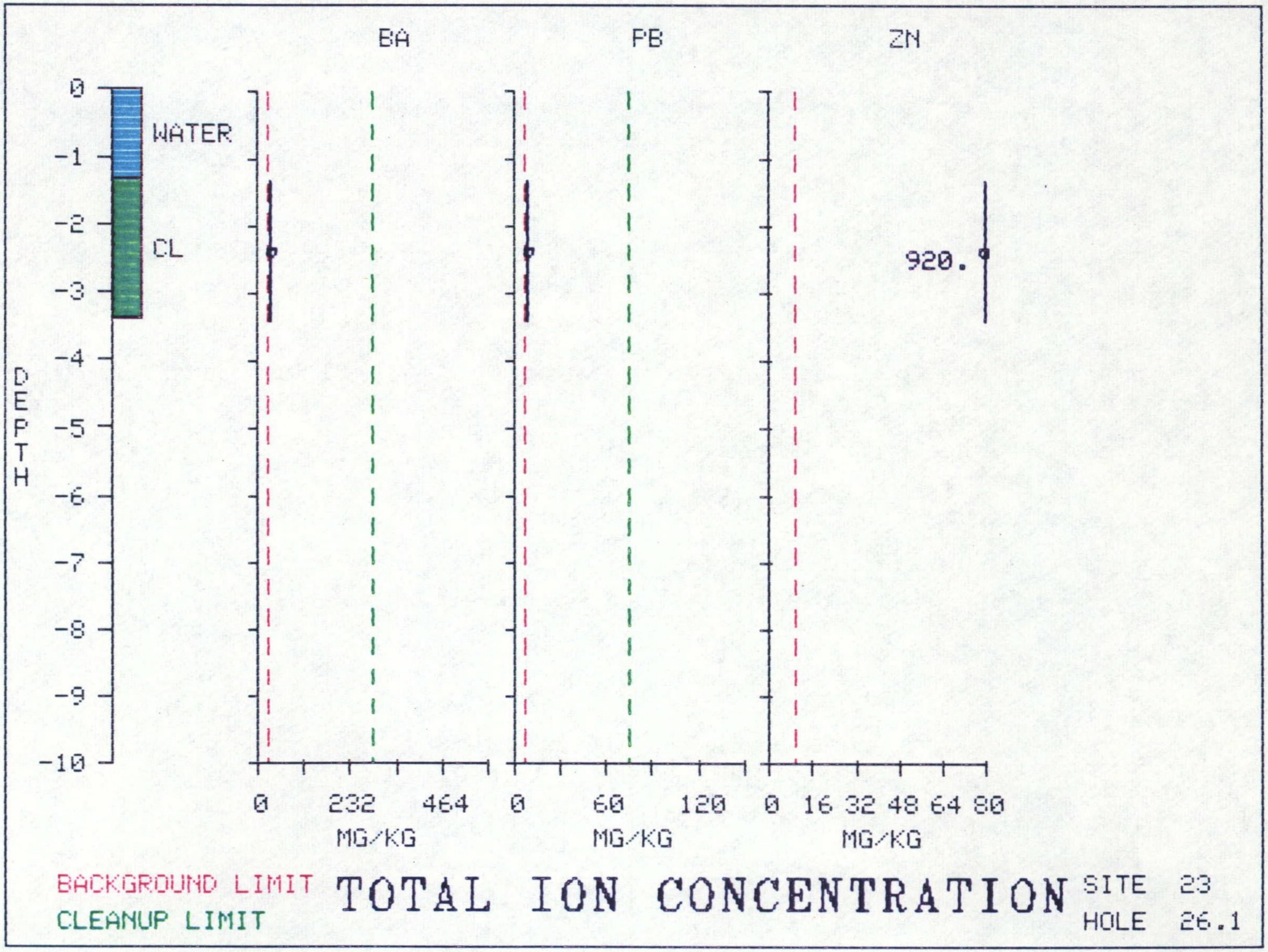


BA
PB
ZN
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
DEPTH
CL
CL-ML
SM
440.
450.
0 232 464
0 60 120
0 16 32 48 64 80
MG/KG
MG/KG
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 25.

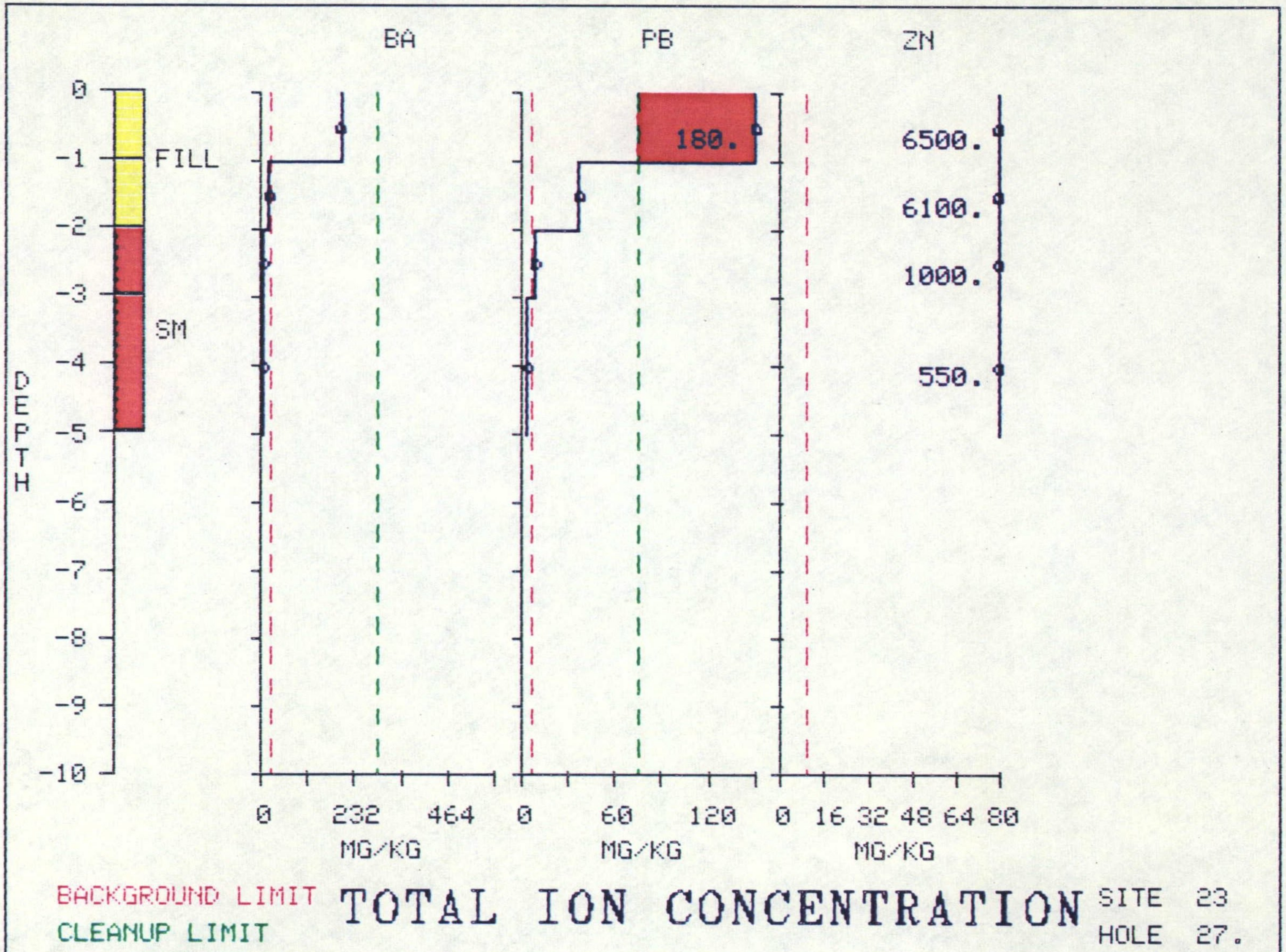

BA
PB
ZN
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
WATER
ML
DEPTH
1400.
0
232
464
0
60
120
0
16
32
48
64
80
MG/KG
MG/KG
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 25.1



BA
PB
ZN
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
DEPTH
CL
SM
0
232
464
MG/KG
0
60
120
MG/KG
0
16
32
48
64
80
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 26.



BA
PB
ZN
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
WATER
CL
DEPTH
920.
0 232 464
MG/KG
0 60 120
MG/KG
0 16 32 48 64 80
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 26.1


BA
PB
ZN
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
DEPTH
FILL
SM
180.
6500.
6100.
1000.
550.
0 232 464
MG/KG
0 60 120
MG/KG
0 16 32 48 64 80
MG/KG
BACKGROUND LIMIT
CLEANUP LIMIT
TOTAL ION CONCENTRATION
SITE 23
HOLE 27.

APPENDIX IV
WASTE COMPATIBILITY TEST REPORTS

27 Mar 85

Results of Compatibility Tests Conducted on PBA Wastes

1. Compatibility tests were performed on waste samples from Pine Bluff Arsenal sites 2, 10A, 17, 20B, 23A, 26, 31, and 34. Test methods followed those proposed by Graves et al (Atch 1). Samples selected for testing had previously been shown to have high total metals content.

2. None of the samples exhibited organic vapor, explosive, flammability, combustibility or water reactivity hazards. None of the samples exhibited oxidation potential and the pH of the samples would allow mixing of the samples. Results of the test are attached (Atch 2).

3. In summary, any of the samples may be mixed with any of the other samples without increasing present risk.

2 Atch

RICHARD G. HUNTER
Environmental Specialist
Tulsa District office
U.S. Army Corps of Engineers

P.S. Compatibility tests were later conducted on waste samples from sites 12 and 29 following test methods given in Attachment #1. These supplemental test results indicated that wastes from Site 12 and the South Area of Site 29, which has non-RCRA characteristics, are full compatible with the wastes from the other sites listed in Paragraph #1. Although the wastes from Site 34 are compatible, they will be disposed in the hazardous waste landfill since they contain certain RCRA-listed organic compounds.

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Tulsa District office
U.S Army Corps of Engineers

PART 2

CHEMICAL CHARACTERIZATION AND BENCH-SCALE COMPOSITING OF HAZARDOUS MATERIALS FOR DISPOSAL CONSIDERATIONS

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THOMAS L. JOHNSON
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Bellevue, Washington

WILLIS L. KEMPER
Roy F. Weston, Inc.
Seattle, Washington

ABSTRACT

Cleanup personnel were faced with the management of 2,900 drums during the immediate removal action at Western Processing Company, a chemical recycling facility in Kent, Washington. After reviewing the data needs and costs of several disposal options, management made the decision to composite the drum contents for disposal. To perform this safely, chemical characterization and bench-scale compositing were performed prior to onsite compositing. Effective field methods to characterize and composite hazardous materials are presented in this paper based on this practical experience.

DECISIONMAKING BY WESTERN PROCESSING CLEANUP MANAGEMENT

Effective use of Superfund monies was a prime consideration during the emergency cleanup of the Western Processing site in Kent, Washington. Western Processing, a chemical recycling operation since 1961, was found to be contaminating a shallow groundwater aquifer and a surface stream running adjacent to the site. During an initial survey of the site, cleanup management discovered 2,900 drums containing a wide variety of materials. Inventory records and drum labels indicated the presence of hydrochloric, nitric, sulfuric, chromic, phosphoric, and hydrofluoric acids; sodium hydroxide; formaldehyde; trichloroethylene;

ink; acetone; freon; methyl ethyl ketone; isopropyl alcohol; zinc oxide; perchloroethylene; methanol; xylene; methylene chloride; toluene; and several other hazardous substances.

Based on the results of the initial survey, site management identified several cleanup options to deal with the Western Processing site. These options included total removal of all materials onsite, partial removal of the material determined to be hazardous, or stabilization of materials onsite to prevent migration offsite. The partial removal option was determined to be the best solution to the immediate problems at Western Processing.[1] By selecting partial removal, site management had to decide which materials to remove, how to remove the materials, and where to dispose of the materials. To identify the potentially hazardous materials, site management decided to chemically characterize each drum on the site. Materials displaying chemically dangerous properties would be removed from the site. Materials that did not pose a particular hazard would be left onsite for possible remedial action later.

Cleanup management also identified the transportation and disposal options for the hazardous materials located at the site. Hazardous materials could either be removed intact in drums or compatible materials could be composited in an onsite batching procedure and transported to a disposal site via tank trucks. Management decided that onsite compositing was the most cost effective method for removing many materials from the site. Generally, a larger volume of material per transport vehicle can be removed in a composite tank or tank truck than on a flatbed truck carrying drums. Onsite compositing reduced disposal costs because disposal sites charge less to accept materials from tank trucks than materials in drums.

CHEMICAL CHARACTERIZATION

When a large number of drums containing different materials are discovered on a site, onsite compositing is a cost effective means to remove the materials from the site. In order to composite the drum materials, the chemical characteristics of the materials in each drum must be determined. Chemical characterization is performed to identify the hazardous materials onsite and to determine which materials are chemically similar for onsite compositing. If chemically dissimilar materials are composited, violent reactions could occur during mixing. Characterization is accomplished by testing drum contents with portable field instruments. Since only general chemical properties are needed to determine which materials are compatible, a complete chemical analysis of the material from each drum is unnecessary. In addition, testing drum contents with field instruments is faster and less costly than laboratory analysis.

Several different characterization schemes have been proposed that require various field tests to characterize materials onsite.[2,3] Some of the possible field tests include:

- radiation
- organic vapors
- pH
- oxidation potential
- reduction potential
- flammability
- combustibility
- solubility
- water reactivity
- flash point

In addition, some existing compatibility schemes test for specific chemicals or chemical groups such as polychlorinated biphenyls (PCBs), cyanides, sulfides, and chlorides.

RECOMMENDED TESTS AND PROCEDURES

Based on the experience gained at the Western Processing site, the following characterization scheme is recommended to chemically characterize drum contents. The information obtained from the recommended procedure includes measures of organic vapors, radiation, pH, flammability, water reactivity, and oxidation potential for each drum.

Prior to conducting the tests, all the drums on a site should be staged and opened. Organic vapor and radiation tests are conducted directly from the drums in the staging area. The other tests must be conducted on samples taken from each drum. Representative samples should be taken using glass rods and transferred to one pint glass jars. A minimum of one-half pint of material is needed to complete the characterization and bench-scale compositing procedures. A characterization table is set up to perform the remaining tests. Testing stations are set up on the table so that as one test is completed, another test may be started. Two persons should work at the table at one time, with each person conducting two different tests. One person tests each sample for pH and flammability while the other person tests each sample for water reactivity and oxidation potential. Several samples may be tested at once to increase the efficiency of the procedure.

Other tests may be performed on drum samples if required by disposal site considerations. Materials containing PCBs must be identified because they may require special disposal methods. Flammables and oils should be tested for PCBs using a portable test kit or by an analytical laboratory. Since PCB tests are costly and time consuming, it is recommended that the PCB analysis be conducted on composited samples obtained during the bench-scale compositing procedure described later. Cyanide and sulfide concentrations may be determined by testing samples with an ion meter using specific probes. These tests also require more time to perform and should be conducted on composited samples during the bench-scale compositing procedure.

The recommended testing procedures and the information obtained from each test are presented below.

Radiation and Organic Vapor Survey

Drums are staged and opened prior to the survey so that the survey can be conducted quickly. Radiation is measured by placing the probe of a radiation meter near the opening of each drum. If the radiation test on any drum is positive, then the drum should be set aside to be disposed of as a radioactive material. Exposure of cleanup personnel to the radioactive material should be avoided and no other tests should be performed on the material. Organic vapors are measured by placing the probe of an organic vapor analyzer or photoionizer into the air space in each drum. A high organic vapor reading from drum material indicates that the material may be flammable. All survey information should be recorded on a drum inventory or characterization data record.

pH Measurement

Transfer 100 ml of sample from the glass sample jar to a 4.5 oz heavy polypropylene cup. The pH of a sample is determined using a multiband pH paper strip. The strip is immersed in the sample and withdrawn. The bands on the paper change color dependent on the pH of the material. The paper is compared to a reference chart indicating specific colors for different pH values.

The pH of a highly colored substance such as waste ink is accomplished using a standard pH meter. A pH meter is not recommended for the majority of the pH tests because the meter probe fouls easily and would require constant maintenance.

Measurement of pH is important, especially in determining compatibility with other materials. High and low pH materials should be segregated because of the violent reactions and possibly toxic substances released when these materials mix. The pH of a material also indicates corrosivity (pH $\leq$2 or >12), which is a concern in transportation and disposal of the material.

Flammability

Using a disposable plastic, closed-bulb pipette, transfer approximately 5 ml of material from the polypropylene cup to a disposable glass vial. Screen the sample in the vial for explosive hazard by placing an ignition source just inside the top of the vial. If the vapors generated by the material at ambient temperatures ignite, the material should be considered flammable and/or potentially explosive. Vapor ignition will be evident by a flame flash at the top of the vial, generally followed by the extinguishing of the ignition source. An electric match, butane lighter, or pilot light are acceptable as an ignition source.

Samples with vapors that do not ignite at ambient temperature should be tested for flammability. Several vials are placed in a rack, covered with loose plastic caps, and immersed in a water bath at a constant temperature of 100°F. Once the materials in the vials have reached the temperature of the water bath, the plastic cap is removed from each vial and an ignition source immediately is placed at the top of the vial. If the vapors from the material ignite, the material is flammable. Materials determined to be nonflammable are further tested for combustibility by raising the temperature of the water bath to 150°F and repeating the ignition test. Materials whose vapors ignite between 100°F and 150°F are considered combustible. Materials whose vapors do not ignite prior to 150°F are considered nonflammable and noncombustible. This procedure is especially efficient when several samples are heated at the same time.

The determination of the flammability or combustibility of a material is important for hazard determination and for transportation and disposal requirements. Flammable and combustible materials present a greater hazard than nonflammable or noncombustible material. In addition, flammable and combustible materials must be properly placarded on transport vehicles. This test procedure may be adjusted if a disposal site has limitations concerning material flash points. Many disposal sites cannot accept materials that exhibit a flash point under a specified temperature. In the flammability test, the water bath temperature may be adjusted to limiting temperatures required by the disposal site. If vapors from the samples ignite at or below this limiting temperature, than another disposal method or disposal site must be found. Most materials with a low flash point may be disposed of by incineration.

Water Reactivity

Place 100 ml of distilled water in a 4.5 oz heavy polypropylene cup. Note the temperature of the water and continue to monitor temperature throughout the procedure. Add 2 ml of sample from the pH measurement cup to the distilled water with a plastic disposable, closed-bulb pipette. If the temperature of the resulting mixture increases, then the material is considered water reactive. Prior to conducting the test, it is imperative to confirm that the distilled water and sample are at the same initial temperature.

Water reactivity is determined for several reasons. The Resource Conservation and Recovery Act defines a material as hazardous if it is reactive with water. The probability that a material on a site will contact water at some time is high, especially material in drums that have deteriorated.

Oxidation Potential

Place 50 ml of 0.001 Normal ferrous ammonium sulfate solution into a 4.5 oz heavy polypropylene cup. Measure the cell potential of the ferrous ammonium sulfate solution using a millivolt (mV) meter with a platinum sensing electrode and standard reference electrode. Remove the electrodes and add 50 ml of sample from the pH measurment cup to the ferrous ammonium sulfate solution. Mix the solutions and let stand for one minute. Measure the change in cell potential of the mixture with the millivolt meter. A change of 50 mV in the positive direction indicates the presence of an oxidizing agent in the sample. Ferrous ammonium sulfate is used in this procedure because it is easily oxidized and the difference in oxidation potential may be measured with the millivolt meter.[4]

If the sample is organic in nature, the mixture may separate into layers. The organic layer of the mixture should be drained off and only the aqueous layer of the mixture is tested. It is important to keep the probes away from organic materials because they will foul and require constant maintenance.

This test is performed because of the violent reactions that take place when an oxidizing agent comes in contact with easily oxidized material. If an oxidizing material is found on a site, it should be segregated from other materials on the site and disposed of separately. In addition, transportation considerations require that oxidizing agents be labelled as oxidizers when transported.

CLASSIFICATION OF CHARACTERIZED MATERIAL

Once all samples have been field tested, the analytical results need to be compiled, preferably by computer. For each sample the following information should be identified: physical state (solid or liquid), radioactivity, oxidation potential, pH, flammability, water reactivity, organic vapor concentration, and any specific analytical results required by the disposal site. PCB concentration should be added following the bench-scale compositing procedure. Based on the data, the characterized samples can be grouped into fairly distinct classes for compositing and/or for disposal. These categories are: radioactive; PCB concentration equal to or greater than 500 ppm; PCB concentration between 50 and 500 ppm; solids; corrosive oxidizers; noncorrosive oxidizers; corrosive acids; corrosive bases; flammables; water reactives; and nonhazardous (Table 1). Additional disposal site analytical requirements may add categories or modify these basic classifications.

Should no further field testing be desired, these classifications allow drums to be segregated for transportation considerations (i.e. to avoid shipping corrosive acids and bases on the same truck). Similarly, the acceptability of materials classed in these categories can be readily identified in regard to the requirements and capabilities of different disposal sites. However, on hazardous waste sites with a large number of drums, this classification scheme lends itself to determining if chemically similar materials within a particular category can

Table 1. Chemical Characterization Classes

SAMPLE CHARACTERISTICS

Classification	Radiation	PCB	Solid	Oxidation Potential	pH	flammability	Water Reactive
Radioactive	Yes	*	*	*	*	*	*
PCB ≥500 ppm	No	≥500 ppm	*	*	*	*	*
PCB 50 ≤ <500 ppm	No	50≥ and <500 ppm	*	*	*	*	*
Solid	No	<50 ppm	Yes	*	*	*	*
Corrosive Oxidizer	No	<50 ppm	No	≥50 mV	0-2	*	*
Noncorrosive Oxidizer	No	<50 ppm	No	≥50 mV	3-14	*	*
Corrosive Acid	No	<50 ppm	No	<50 mV	0-2	*	*
Corrosive Base	No	<50 ppm	No	<50 mV	12-14	*	*
Flammable	No	<50 ppm	No	<50 mV	3-11	Yes	*
Water Reactive	No	<50 ppm	No	<50 mV	3-11	No	Yes
Nonhazardous	No	<50 ppm	No	<50 mV	3-11	No	No

* Result irrelevant; prior category has greatest importance

be composited for more economical shipping and disposal. Furthermore, should it be desirable to ship commercially-viable products to a recycling facility rather than a disposal site, this classification method will provide general evidence to confirm or deny the site operator's labelling of product materials. At the Western Processing site, this categorization allowed the culling of drums labelled as containing viable products, when in fact the chemical characteristics identified through field testing indicated that the materials in many drums could not possibly be the products specified by the labels.

BENCH-SCALE COMPOSITING

Bench-scale compositing of similar materials is a necessary step prior to onsite compositing of the contents of drums for several reasons. First of all, it provides a general confirmation of the chemical characterization classification of different samples. It also determines the compatibility of materials within a given classification. Finally, it provides a safety margin for subsequent onsite compositing by eliminating incompatible materials from compositing consideration and by identifying possible reactions to expect with full scale compositing.

Not all of the categories in the classification scheme should be considered for compositing. Classes such as radioactive, PCB containing, solid, corrosive oxidizer, and noncorrosive oxidizer probably should be shipped for disposal in intact drums on flatbed trucks. Compositing of corrosive acids or corrosive bases is not always advisable. If compositing is attempted, special care should be taken because of the violent reactions which can occur, particularly when large scale compositing is attempted later.[1] The prime candidates for compositing are flammables, water reactives, and, if necessary, the nonhazardous class.

The basic concept for bench-scale compositing is to take a small quantity of material from samples in the same category, mix them one sample at a time, and observe any reaction. Temperature rise and the generation of gases are the primary reactions to watch for. Reactive samples should be identified and excluded from later onsite compositing. When hundreds of samples are involved in the compositing process, a portion of the composited material should be set aside when moderate quantities have been mixed. This minimizes the possibility that due to a reaction with a later addition, the entire composited quantity has to be discarded, and the entire process redone. The following procedures were implemented during the Western Processing site cleanup, worked well, and are recommended for other sites.

All drum samples falling within the chemical classification to be composited were staged on a table. A small cup with a thermometer was set up behind a clear plastic shield. A plastic disposable, closed-bulb pipette was used to draw off a small (3-5 ml) representative aliquot from each sample bottle to be placed in the mixing cup. Careful recording was made of each sample added to the batch. As each subsequent aliquot was added to the mixing cup, the temperature was monitored. If a temperature increase of over 10°F was detected, the added material was considered to be reactive. The selected temperature change was chosen on the advice of the EPA Environmental Response Team. Any material which exhibited reactivity with the batch was set aside and identified as a drum to be segregated onsite and disposed of separately. Once a reaction was noted, the tainted batch was discarded, the nonreactive samples were remixed, and the compositing process was continued.

After 10-15 samples had been mixed successfully, half the mixture was set aside in a labelled flask as a backup. The remaining mixture continued to serve as the compositing medium. Another 10-15 samples were added one at a time and examined for any reactivity with the mixture. If a reaction occurred, that particular sample was removed from consideration for onsite compositing, and the entire mixture was discarded. Either all or a portion of the backup mixture (depending on the available quantity) was placed in the mixing cup, aliquots of the nonreactive samples in the latest group were remixed, and compositing was continued. Again, once 10-15 samples were successfully composited, half of the composited material was added to the mixture in the backup flask. These procedures were maintained until all samples in the group had been tested. This same bench-scale approach was then used to batch other groups and individual products. The final results of the bench-scale compositing were lists of batchable drums within each group and a list of drums to be shipped offsite individually.

At Western Processing several other considerations arose concerning disposal site requirements. The presence of cyanide was a concern for one disposal site, so a cyanide probe was set up and added as a step in the compositing process. Due to the sensitivity of the probe it was highly desirable to avoid having to test every sample. Instead, once 10-15 samples had been composited in the mixing cup, the mixture was tested for the presence of cyanide. If a positive response greater than 10 ppm (the disposal site level of concern) was noted, each of the samples present in the mixture were tested individually. Samples above the threshold for cyanide were excluded from onsite compositing consideration. It was recognized that sulfides present would interfere with the cyanide test; however, because the procedure to distinguish between cyanide and sulfide was sensitive and time consuming, it was decided to simply be conservative and assume the cyanide probe reading was due solely to cyanide.

PCBs and flash points were also of concern in the compositing process. Although PCB analyses had been run onsite by the EPA Environmental Emergency Response Unit's Mobile Laboratory from Edison, New Jersey, for each of the individual samples, an additional PCB analysis was performed on the final batch mixture for each of the classifications that were composited. Similarly, a closed-cup flash point measurement unit was set up and all final mixtures also had their flash points determined.

ONSITE COMPOSITING

Onsite compositing is performed with drums that have previously been determined to be compatible during the bench-scale compositing procedure. While the bench-scale testing is a simulation of onsite compositing, large scale mixing of materials could promote reactions not observed during the bench-scale procedures. In addition, if the samples used in the bench-scale compositing procedure are not representative of the drum contents, an incompatible material may be added to the composite, causing a reaction. To decrease the magnitude of possible reactions, precautions should be taken when compositing drums. Drums should be composited in the same order as during the bench-scale compositing procedure. Drum materials should be composited slowly and the mixing vessel continuously monitored. If the temperature in the mixing vessel increases or vapors are released, compositing should be discontinued until the materials have completely reacted.

Ideally, a large compatibility chamber or open tank should be used as a reaction vessel. Tank or vacuum trucks may be used if an open vessel is not available. If trucks are used however, they should be monitored carefully during compositing because violent reactions could damage these trucks. The mixing vessel must be made of materials that do not react with the drum contents. Corrosive materials should be mixed in rubber-lined tanks while organics are best composited in metal tanks.

Drum contents are added to the mixing vessel using a drum grappler, hose and pump, or vacuum truck. A drum grappler is the best method of emptying drums because workers are less likely to contact drum materials.

Once all the compatible materials of one classification are composited, samples of the composite may be taken for further analysis. Since most disposal sites require that the flash point of the composite be measured, this test may be performed on the composite sample. The composite sample may also be used to identify the specific chemicals that were onsite by having a laboratory analyze the sample.

SAFETY CONSIDERATIONS

Personnel safety is an important consideration during any site cleanup. The procedures described for characterization, bench-scale compositing, and onsite compositing must be conducted so that exposure to hazardous substances is prevented. Since personnel performing these procedures are at risk to exposure, appropriate respiratory and skin protection must be provided. Respiratory protection for characterization, bench-scale compositing, and onsite compositing should be provided by a back-mounted gas mask or full face respirator equipped with a combination particulate, organic vapor, and acid gas canister. This level of protection is required because of the highly volatile or toxic gases that may be released during these procedures. A self contained breathing apparatus should be used if the characterization procedure is conducted inside or in a poorly ventilated area. If any of these procedures are conducted onsite, personnel must follow the appropriate level of respiratory protection set by the site safety officer. Ambient air monitoring should be conducted during the characterization and compositing procedures. Monitoring will determine if and to what extent these procedures are contaminating the ambient air. In addition, the level of respiratory protection may be upgraded if contaminants in the ambient air are determined to be too high.

Skin protection should be provided by a hard hat or chemical resistant hood, plastic face-shield, chemical resistant or plastic coated coveralls, rubber apron, inner and outer chemical resistant gloves, and steel-toed, steel shank rubber boots. This equipment provides splash and spill protection from possibly corrosive and toxic materials. A decontamination area should be provided so that workers may dispose of soiled protective equipment and completely wash themselves. Emergency decontamination procedures should be set up to be followed if a worker becomes grossly contaminated.

Due to the exothermic nature of most chemical reactions, fire is a real danger during characterization and compositing. Chemical fire extinguishers should be readily available to put out small fires. Since large fires could be generated during onsite compositing, local fire departments should be notified prior to full scale compositing.

SUMMARY

Onsite compositing is an economical method of handling hazardous materials from a waste site. Transportation and disposal costs are reduced when drum materials are composited rather than removed intact. In order to perform onsite compositing, drum materials must be chemically characterized. Characterization identifies the hazardous materials on a site and determines which materials may be composited. The characterization procedure is flexible and may be altered to perform other tests as required by a disposal site. A bench-scale compositing procedure is performed to ensure that drum materials with similar chemical properties are compatible and to minimize problems during onsite compositing.

REFERENCES

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2. Turpin, R. D., Lafornara, J. P., Allen, H. L., and Frank, U., "Compatibility Field Testing Procedures For Unidentified Hazardous Wastes", Proceedings of the National Conference on Management of Uncontrolled Hazardous Waste Sites, October 28-30, 1981, Washington, D.C. pp. 110-113.
3. Stroud, F. B., Burrus, B. G., and Gilbert, J. M., "A Coordinated Cleanup of the Old Hardin County Brickyard, West Point, Kentucky", Proceedings of the National Conference on Management of Uncontrolled Hazardous Waste Sites, November 29 - December 1, 1982, Washington, D.C. pp. 274-279.
4. Turpin, R. "Oxidation/Reduction Potential Field Test Kit for Use at Hazardous Materials Spills", Proceedings of the 1982 Hazardous Materials Spills Conference. April 19 - 22, 1982, Milwaukee, WI. pp. 225-227.

ACKNOWLEDGEMENTS

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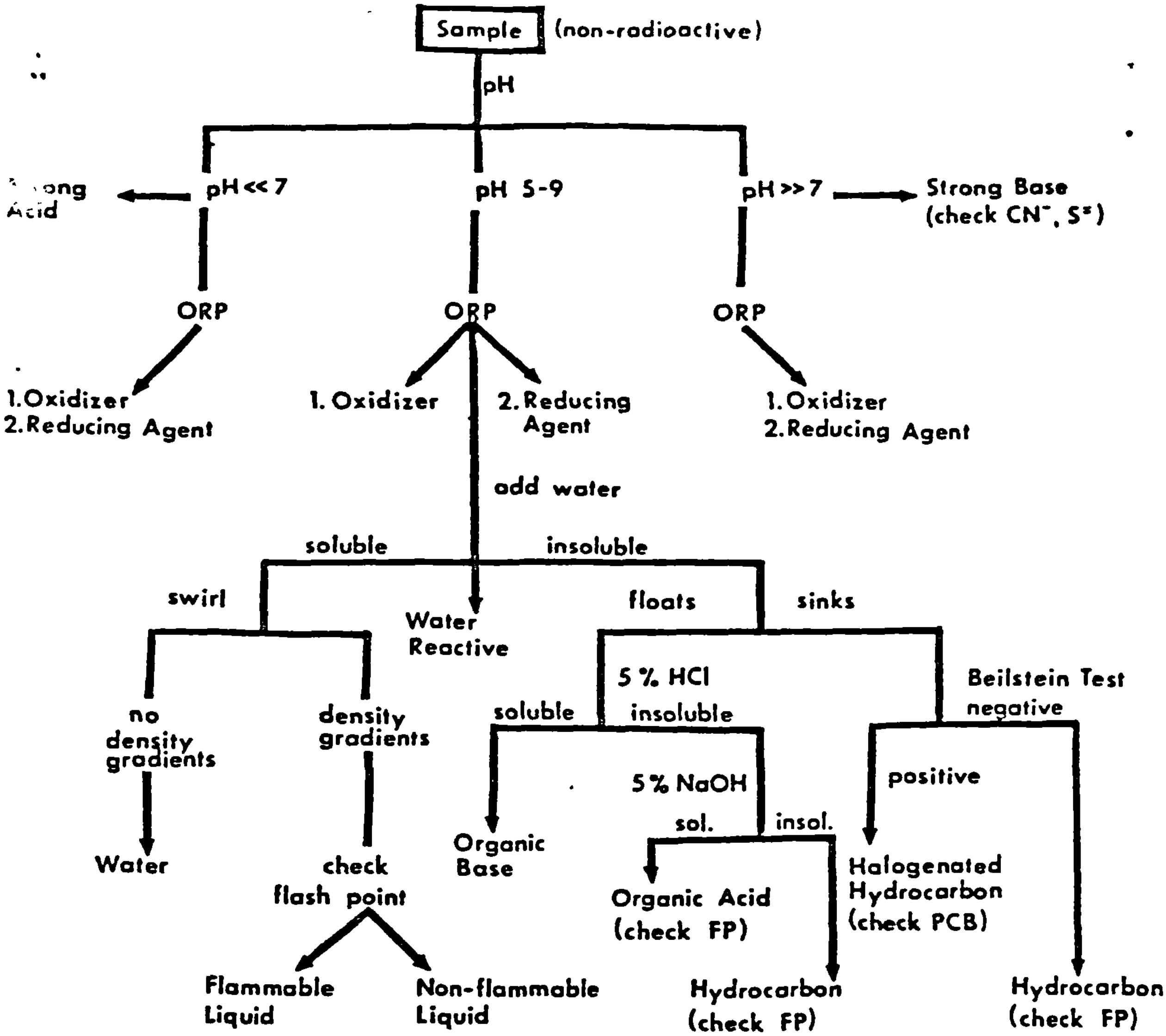
PART 3

COMPATIBILITY TREE



SCREENS FOR: 1. Strong Acids
2. Strong Bases
3. Oxidizers
4. Reducing Agents
5. Cyanides & Sulfides
6. Water Reactives
7. Flammable Liquids
8. Halogenated Hydrocarbons
9. PCB's

COMPATIBILITY TEST-SITE 2

Organic vapor None

pH 5.6

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74° F end temp 74° F

Oxidation potential 0

Ambient temperature during testing 74° F

Tests performed by:

RICHARD G. HUNTER
Environmental Specialist

Note: Sample taken From Boring 2-1 at depth of 1.0 to 2.0 Feet.

COMPATIBILITY TEST-SITE 2

Organic vapor None

pH 5.8

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74°F end temp 74°F

Oxidation potential 0

Ambient temperature during testing 74°F

Tests performed by:

RICHARD G. HUNTER
Environmental Specialist

Note: Sample taken From Boring 2-10 at depth of 0-1.0 Feet.

COMPATIBILITY TEST-SITE 10A

Organic vapor None

pH 4.3

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74°F end temp 74°F

Oxidation potential 0

Ambient temperature during testing 74°F

Tests performed by:

Richard G. Hunter

RICHARD G. HUNTER
Environmental Specialist

Note: Sample taken From Boring 10-1 at depth of 0.1 to 1.0 Feet.

JUL 2 - 1985

COMPATIBILITY TEST-SITE PBA - 12-2

Organic vapor Minor

pH 8.4

Explosive hazard @ ambient temp none

Flammability @ 100°F none

Combustibility @ 150°F none

Water reactivity - initial temp 22°C end temp 22°C

Oxidation potential -108.7

Ambient temperature during testing 21°C

Tests performed by:

James C. Staves II

JAMES C. STAVES, II
Biologist

Note: Sample taken From Boring 12-2 at depth oF 8-10.5 Feet.

COMPATIBILITY TEST-SITE PBA 12-6

Organic vapor None

pH 10.0

Explosive hazard @ ambient temp none

Flammability @ 100°F none

Combustibility @ 150°F none

Water reactivity - initial temp 22°c end temp 22°c

Oxidation potential -163.8

Ambient temperature during testing 21°c

Tests performed by:

James C. Staves II

JAMES C. STAVES, II
Biologist

Note: ~~[illegible]~~ Sample taken From Boring 12-6 at depth of 0-0.7 Feet.

COMPATIBILITY TEST-SITE PBA -12-16

Organic vapor None

pH 10.0

Explosive hazard @ ambient temp none

Flammability @ 100°F none

Combustibility @ 150°F none

Water reactivity - initial temp 22°c end temp 22°c

Oxidation potential -114.1

Ambient temperature during testing 21°c

Tests performed by:

James C Staves II

JAMES C. STAVES, II
Biologist

Note: Sample taken From Boring 12-14 at depth of 0-1.0 Feet.

COMPATIBILITY TEST-SITE 17

Organic vapor None

pH 6.6

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74°F end temp 74°F

Oxidation potential 0

Ambient temperature during testing 74°F

Tests performed by:

Richard G. Hunter

RICHARD G. HUNTER
Environmental Specialist

Note: Sample taken from Boring 17-2 at depth of 0 to 1.0 feet.

COMPATIBILITY TEST-SITE 20B

Organic vapor None

pH 5.6

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74°F end temp 74°F

Oxidation potential 0

Ambient temperature during testing 74°F

Tests performed by:

Richard G. Hunter

RICHARD G. HUNTER
Environmental Specialist

Note: Sample taken From Boring 20-12 at depth of 0 to 1.0 Feet.

COMPATIBILITY TEST-SITE 23A

Organic vapor None

pH 6.9

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74° F end temp 74° F

Oxidation potential O

Ambient temperature during testing 74° F

Tests performed by:

Richard G. Hunter

RICHARD G. HUNTER
Environmental Specialist

Note: Sample taken from Boring 23-1 at depth of 5.0 to 8.0 Feet.

COMPATIBILITY TEST-SITE 26

Organic vapor None

pH 9.7

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74°F end temp 74°F

Oxidation potential n

Ambient temperature during testing 74°F

Tests performed by:

Richard G. Hunter

RICHARD G. HUNTER
Environmental Specialist

Note: Sample taken From Boring 26-9 at depth of 0 to 0.2 Feet

COMPATIBILITY TEST-SITE 29 - 2   1.0 - 2.0

Jar 2.0

Organic vapor None

pH 8.3

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74°F   end temp 74°F

Oxidation potential 240.9

Ambient temperature during testing 74°F

Tests performed by:

James C Staves II

JAMES C. STAVES, II
Biologist

Note: Sample taken From Boring 29-2 at depth of 1.0 to 2.0 Feet.

COMPATIBILITY TEST-SITE 29-28 0-1.0
Jar 1

Organic vapor None

pH 8.6

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74°F end temp 74°F

Oxidation potential 352.7

Ambient temperature during testing 74°F

Tests performed by:

James C. Staves II

JAMES C. STAVES, II
Biologist

Note: Sample taken From Boring 29-28 at Depth of 0 to 1.0 Feet.

COMPATIBILITY TEST-SITE 31 -

Organic vapor None

pH 7.7

Explosive hazard @ ambient temp None

Flammability @ 100^{o}F None

Combustibility @ 150^{o}F None

Water reactivity - initial temp 74°F end temp 74°F

Oxidation potential 0

Ambient temperature during testing 74°F

Tests performed by:

RICHARD G. HUNTER
Environmental Specialist

Note! Sample taken From Boring 31-8 at depth oF 0 to 0.4 Feet.

COMPATIBILITY TEST-SITE 34

Organic vapor None

pH 5.2

Explosive hazard @ ambient temp None

Flammability @ 100°F None

Combustibility @ 150°F None

Water reactivity - initial temp 74°F end temp 74°F

Oxidation potential 0

Ambient temperature during testing 74°F

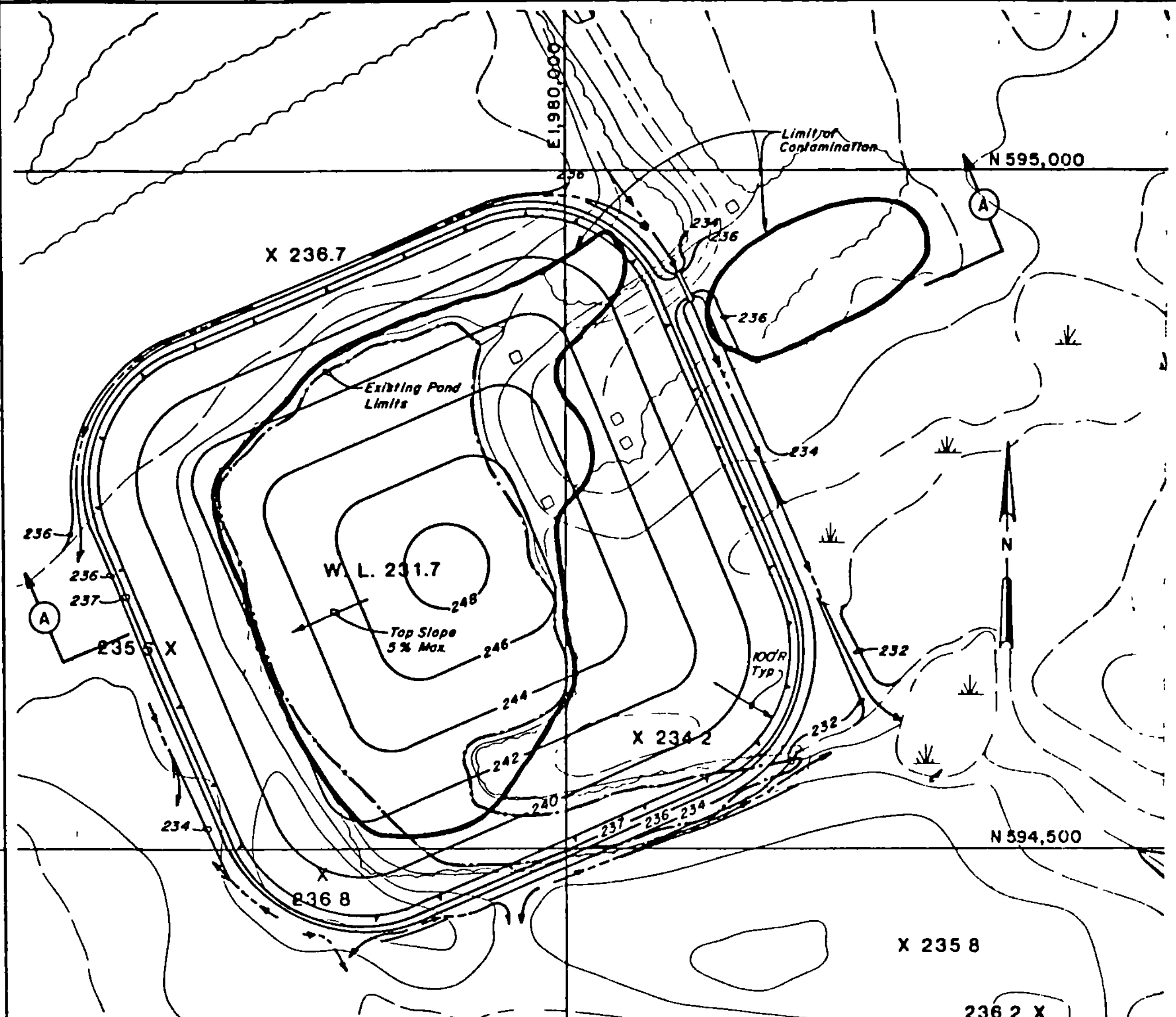
Tests performed by:

Richard G. Hunter

RICHARD G. HUNTER
Environmental Specialist

Note: Sample taken From Sediment Sample SD-1, the pond sediment From the North Shore.

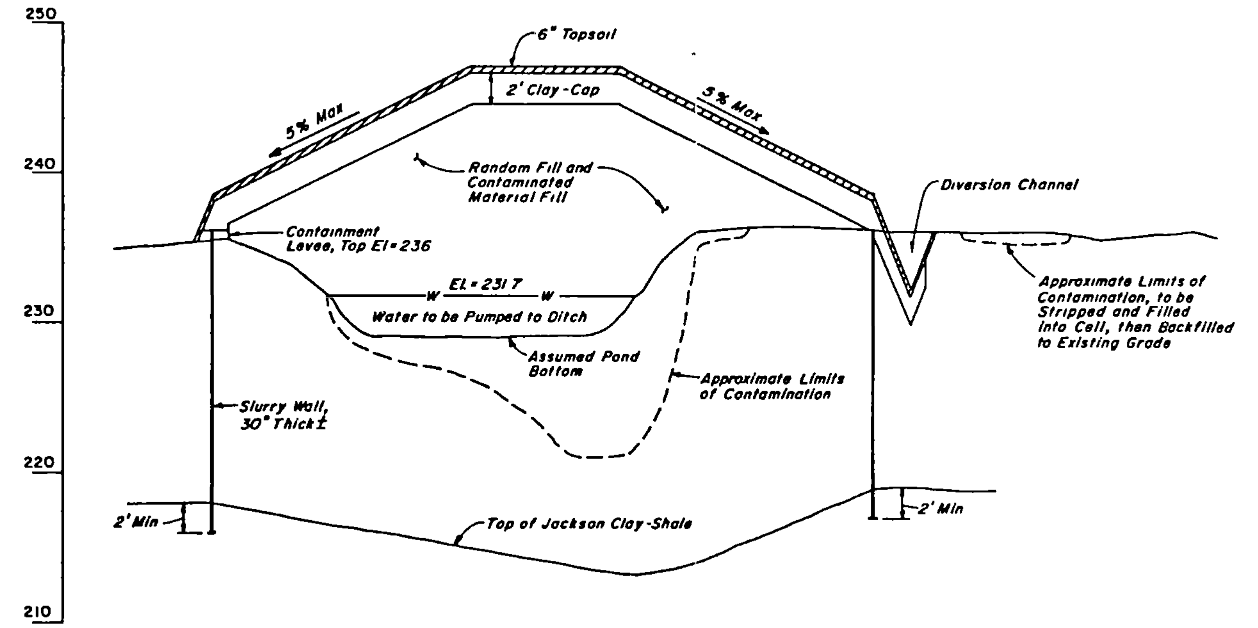
DRAWINGS



CLOSURE PLAN

SCALE IN FEET

50 0 50 100

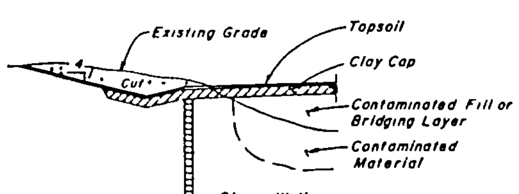


SECTION A-A

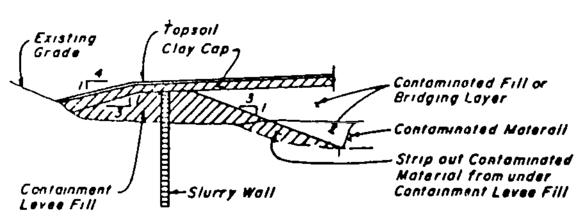
Notes

1 Contaminated material located inside Slurry Wall limits shall be closed in place without disturbance

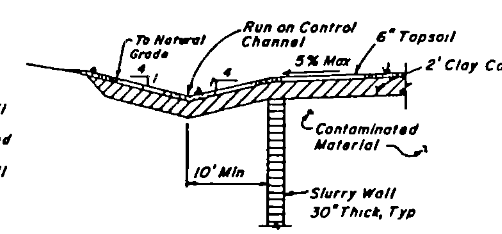
2 Contaminated material located outside or conflicting with Slurry Wall construction limits shall be excavated and stockpiled on-site Upon completion of pond dewatering, this material shall be placed within the limits of the dewatered pond



TYPICAL SECTION ALONG SLURRY WALL CUT REQUIRED



TYPICAL SECTION ALONG SLURRY WALL CONTAINMENT LEVEE REQUIRED



TYPICAL SECTION-SLURRY WALL, RUN ON CONTROL CHANNEL

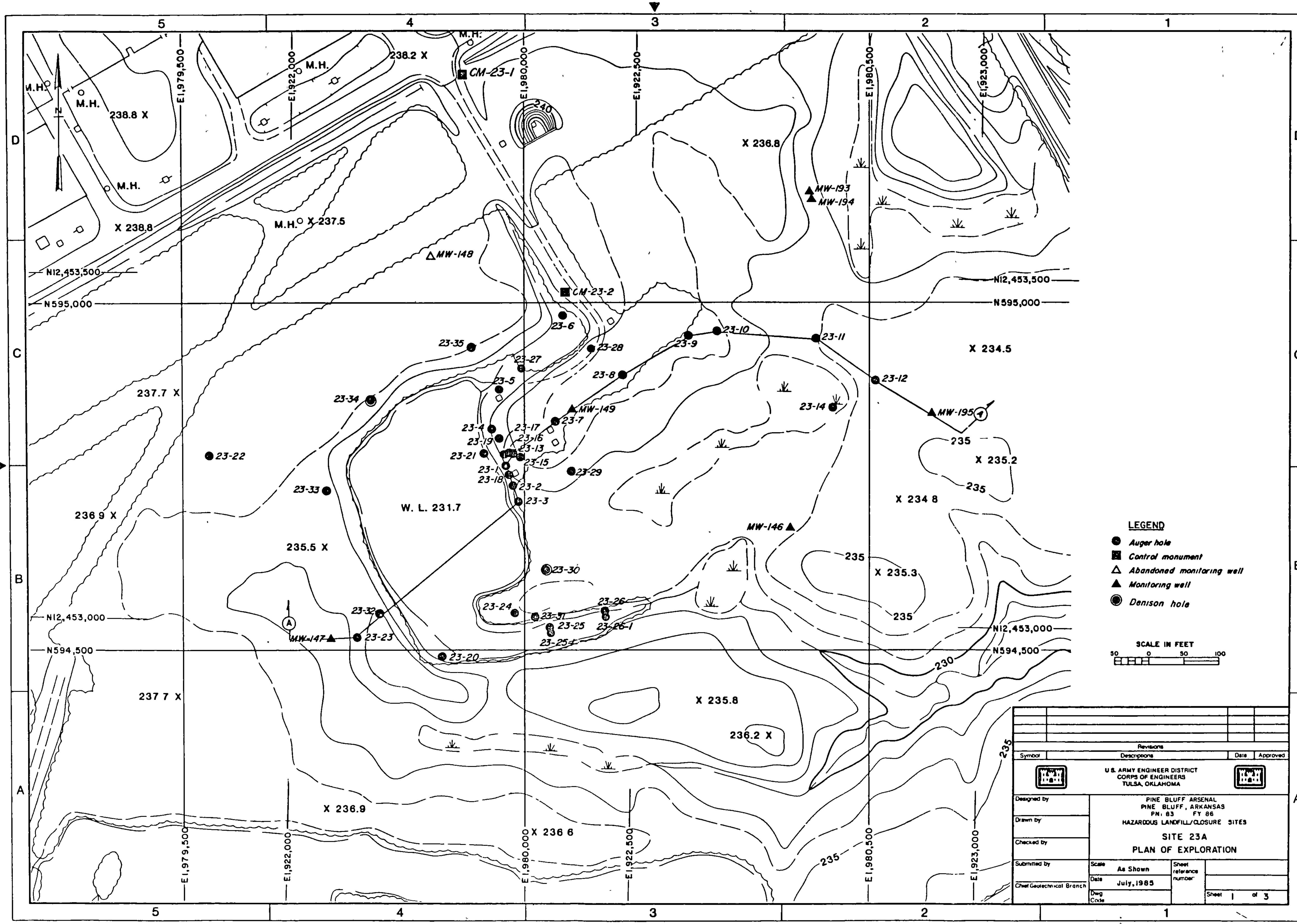
LEGEND

- EXTENT OF CONTAMINATION
- SLURRY WALL ALIGNMENT
- RUN ON CONTROL CHANNEL
- 234 — FINAL CONTOUR
- CULVERT
- MONITORING WELL
- EXISTING POND LIMITS

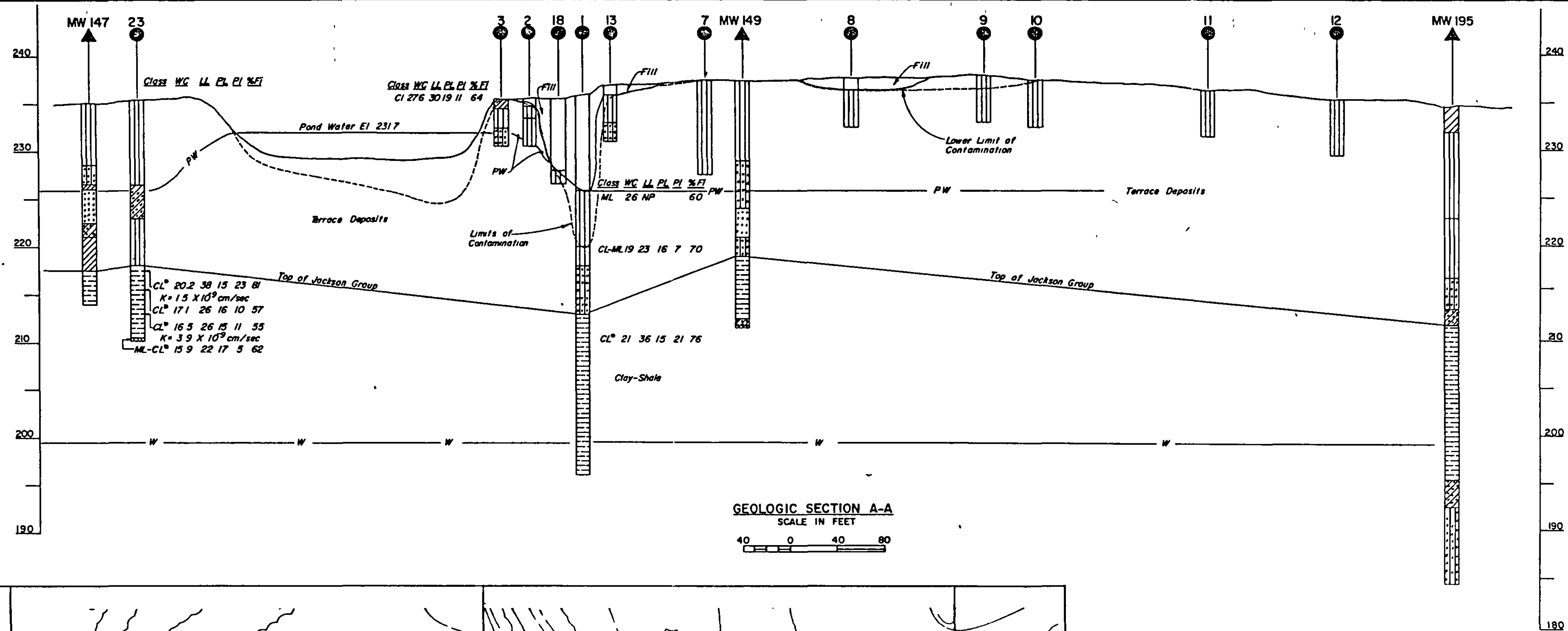
Symbol	Descriptions	Date	Approved
	Revisions		

U S ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA OKLAHOMA

Designed by R WHITE	PINE BLUFF ARSENAL PINE BLUFF ARKANSAS PN 63 FY 86 HAZARDOUS LANDFILL/CLOSURE SITES
Drawn by T INGRAM	SITE 23A CLOSURE PLAN
Checked by	
Submitted by	Scale As Shown
Chief	Date July,1985
	Dwg Code
Sheet reference number	Invitation No DACA 56- -B
	Contract No DACA 56- -C
	Sheet 3 of 3



LEGEND
Auger hole
Control monument
Abandoned monitoring well
Monitoring well
Denison hole
SCALE IN FEET
50 0 50 100
W. L. 231.7
CM-23-1
CM-23-2
MW-146
MW-147
MW-148
MW-149
MW-193
MW-194
MW-195
N595,000
N594,500
N12,453,500
N12,453,000
E1,979,500
E1,922,000
E1,980,000
E1,922,500
E1,980,500
E1,923,000
M.H.
Revisions
Symbol
Descriptions
Date
Approved
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA
PINE BLUFF ARSENAL
PINE BLUFF, ARKANSAS
PN: 83 FY 86
HAZARDOUS LANDFILL/CLOSURE SITES
SITE 23A
PLAN OF EXPLORATION
Designed by
Drawn by
Checked by
Submitted by
Chief Geotechnical Branch
Scale
As Shown
Date
July, 1985
Dwg Code
Sheet reference number
Sheet 1 of 3



GEOLOGIC SECTION A-A
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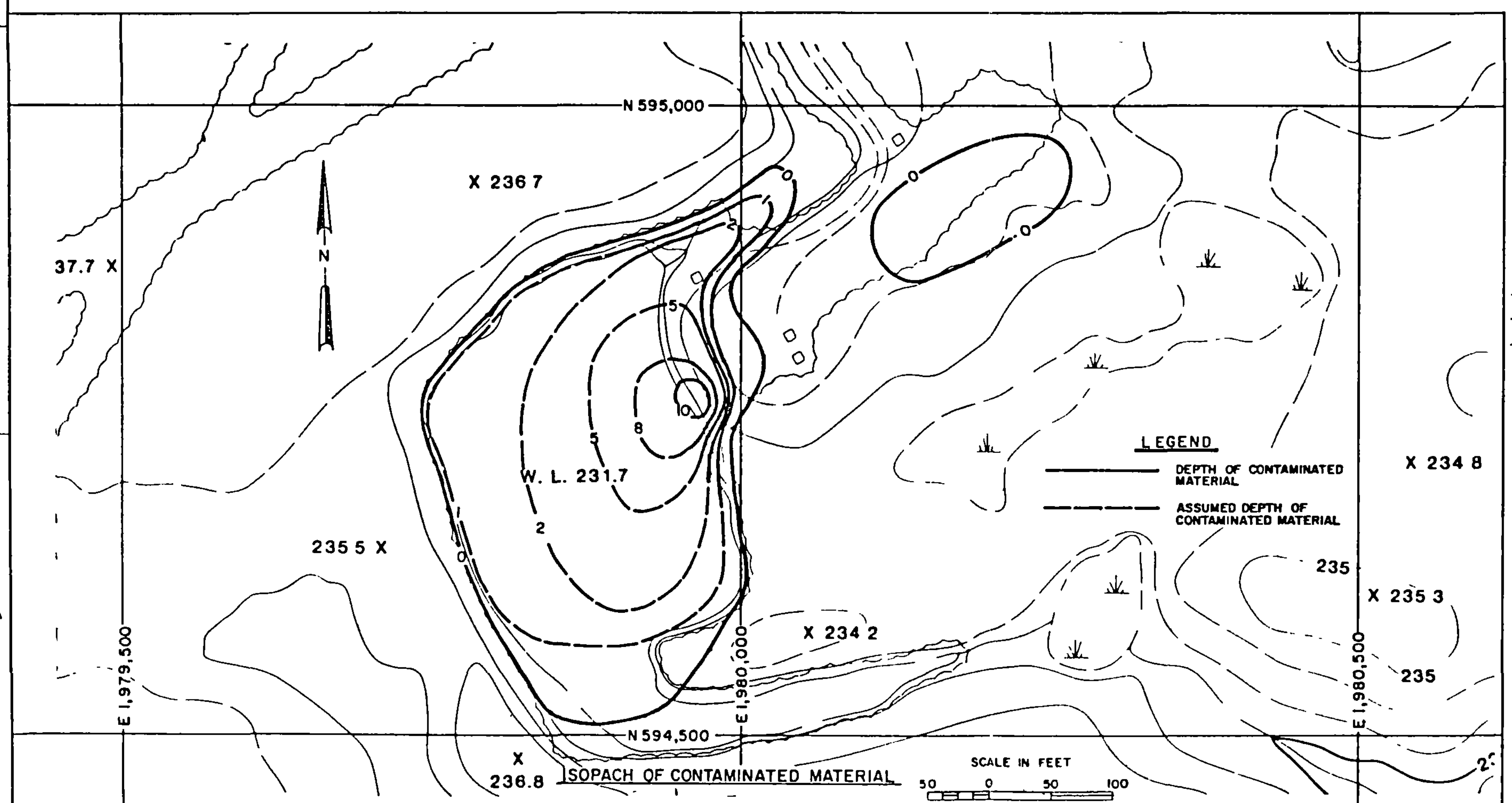

ISOPACH OF CONTAMINATED MATERIAL
SCALE IN FEET
50 0 50 100

LEGEND

- AUGER HOLE
- MONITORING WELL
- CONTROL MONUMENT
- * SOIL CLASSIFICATION PERFORMED ON CLAY-SHALE
- -W- WATER TABLE
- -PW- PERCHED WATER
- ----- LIMITS OF CONTAMINATION

- FILL MATERIAL
- CL, LOW PLASTICITY CLAY
- CH, HIGH PLASTICITY CLAY
- SC, CLAYEY SAND
- ML, SILT, ML-CL SILTY CLAY
- SM, SILTY SAND
- SP, SAND
- CLAY-SHALE

Class	UNIFIED SOIL CLASSIFICATION SYSTEM
WC	WATER CONTENT
LL	LIQUID LIMIT
PL	PLASTIC LIMIT
PI	PLASTICITY INDEX
%FI	PERCENT FINES

Symbol	Descriptions	Date	Approved
	Revisions		

U S ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA OKLAHOMA

Designed by	PINE BLUFF ARSENAL PINE BLUFF, ARKANSAS PN 83 FY 86 HAZARDOUS LANDFILL/CLOSURE SITES
Drawn by: T INGRAM	SITE 23A
Checked by R WHITE	ISOPACH OF CONTAMINATED MATERIAL AND GEOLOGIC SECTION A-A
Submitted by	Scale As Shown
Chief	Date July, 1985
	Dwg Code

Sheet reference number	Invitation No DACA 56-84 B
	Contract No DACA 56-84 C
	Sheet 2 of 3